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# NATIONAL GEOGRAPHIC



## dinosaurs

Cracking the mystery of how they lived

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# WEST INDIES

**NATIONAL GEOGRAPHIC**

With bold geographic ambitions but without an accurate map in his hand, Christopher Columbus set out from Europe to find a western passage to India. Centuries later the West Indies have become a popular destination for travelers who seek little more than relaxation and fun in the sun. Yet beyond the sand, surf, and picturesque islands comes a faint echo of a bold and brutal history of colonization. Spanish, French, British, and Dutch invaders all came to compete over and occupy the islands. Most eventually went home, but their legacy remains broad, deep, and indelible.

**Bahamas**

Of the roughly 700 islands that make up the archipelago of the Bahamas, only 18 or so have been developed. New Providence, one of the smallest of the major islands, is home to two-thirds of the population, much of it clustered around Nassau, the political and tourist capital. Columbus once described these islands as "the best in the world." Their beauty and charm—the fish, the flamingos, and more—now attract thousands of tourists, who also come to golf, shop, and gamble.

AREA	5,382 sq mi (13,939 sq km)
POPULATION	312,000
CAPITAL	Nassau
LANGUAGE	English, Creole
CURRENCY	Bahamian dollar, U.S. dollar
GOVERNMENT	Parliamentary democracy

**U.S. Virgin Islands**

Duty-free shopping, fine dining, and pulsating nightlife are just a few of the attractions that lure a million or so tourists to St. Thomas every year. Visitors who hang for a bit of history—the days when rum and sugar fueled the local economy—can wander through sugar mills and plantations on the island of St. John. The island of St. John offers more solitude and tranquility: Roughly two-thirds of the island is protected by a national park.

AREA	136 sq mi (352 sq km)
POPULATION	110,000
CAPITAL	Charlotte Amalie
LANGUAGE	English, Spanish, Creole
CURRENCY	U.S. dollar
GOVERNMENT	U.S. territory; democracy

**British Virgin Islands**

On many of these 40 limestone islands and cays, trees and topsoil are scarce. Less still means less salt—and clearer water. Toss in one of the world's longest and healthiest reef systems, plus some 200 species of fish, and the result yields exceptional conditions for snorkeling and scuba diving.

AREA	59 sq mi (150 sq km)
POPULATION	21,000
CAPITAL	Road Town
LANGUAGE	English
CURRENCY	U.S. dollar
GOVERNMENT	British overseas territory; democracy

**St. Martin (St. Maarten)**

Originally built in 1943 as a U.S. military airfield, Princess Juliana Airport now serves as a gateway for tourists who come to explore the world's smallest bi-national island. Traveling between Dutch St. Maarten in the south and French St. Martin in the north, visitors cross an international border as unobtrusively as drivers on the road as it is to birds in the sky.

AREA	37 sq mi (96 sq km)
POPULATION	29,000 (French side); 39,000 (Dutch side)
CHIEF TOWN	Marigot (French side); Philipsburg (Dutch side)
LANGUAGE	French, Dutch, English
CURRENCY	Euro, Netherlands Antilles guilder, U.S. dollar
GOVERNMENT	Dependency of Guadeloupe, democracy (French side); part of the Netherlands Antilles, democracy (Dutch side)

**Guadeloupe**

From the air Guadeloupe's two largest islands resemble the wings of a butterfly, but on the ground they are far from symmetrical. To the west stands Basse-Terre, a mountainous island of volcanic origin, with dense rain forests at its heart and black volcanic sands on its western beaches. To the east Grande-Terre is a low limestone outcrop with plenty of white sand beaches, hotels, resorts, and restaurants serving Creole food.

AREA	687 sq mi (1,780 sq km)
POPULATION	481,000
CAPITAL	Basse-Terre
LANGUAGE	French, Creole, some English
CURRENCY	Euro
GOVERNMENT	Overseas department of France; democracy

**St. Lucia**

Beaches and banana plantations frame St. Lucia's mountainous rain forest, home to rare and threatened species such as the St. Lucia parrot. Captivated for the pet trade and hunted as a source of food, the parrot dwindled to fewer than 100 by 1971. Thanks to popular support for new forest reserves, education programs, and a hunting ban, the parrot population has rebounded to perhaps as many as 500 today.

AREA	288 sq mi (617 sq km)
POPULATION	166,000
CAPITAL	Castries
LANGUAGE	English, French patois
CURRENCY	Eastern Caribbean dollar
GOVERNMENT	Parliamentary democracy

**Cayman Islands**

In the currents of Bloody Bay, off Little Cayman, neon-colored sponges undulate in the sun. In the shadows of Stingray City ("the world's best 12-foot-deep") currents hand-fed flotillas of rays. Near Hell, a small town on Grand Cayman, the beach bristles with black jagged rocks. A favorite destination of scuba divers, the Caymans are also a haven for rich people seeking to evade taxes. Law enforcement authorities scrutinize many offshore banks in the Caribbean for their reputed ties to money-laundering operations.

AREA	100 sq mi (259 sq km)
POPULATION	45,000
CAPITAL	George Town
LANGUAGE	English
CURRENCY	Cayman Islands dollar, U.S. dollar
GOVERNMENT	British overseas territory; democracy

**Antigua & Barbuda**

If it's a beach, Antigua, which boasts 385 of them, has a year's worth. Barbuda boasts beautiful beaches too, some with pinkish sand, but the island's lack of well-paved roads makes many of them far tougher to reach. Navigating around these islands has always been a challenge because of treacherous surrounding reefs, which have claimed nearly 150 ships since 1695.

AREA	170 sq mi (440 sq km)
POPULATION	97,000
CAPITAL	St. John's
LANGUAGE	English, local dialects
CURRENCY	Eastern Caribbean dollar, U.S. dollar
GOVERNMENT	Parliamentary democracy

**Martinique**

"Mythical" France. Arriving from Trinidad, you'll find you've crossed not the Caribbean but the English Channel." So wrote V. S. Naipaul in "The Middle Passage" in 1950—and little has changed since then. Martinique remains a department of France, which is also the island's major trading partner. More than half of Martinique's principal exports—bananas, pineapples, and rum—go to France.

AREA	425 sq mi (1,100 sq km)
POPULATION	384,000
CAPITAL	Fort-de-France
LANGUAGE	French, Creole, some English
CURRENCY	Euro, U.S. dollar
GOVERNMENT	Overseas department of France; democracy

**Barbados**

Perched on the eastern wing of the West Indies, Barbados looks as if it might be drifting away toward Europe—and in many ways it's done just that. Even since English settlers first arrived in 1627, the island has conveyed a distinctly British air. Even now cricket is the national sport, Queen Elizabeth II is the head of state, and Boxing Day is a public holiday. Almost half of all tourists come from the United Kingdom.

AREA	168 sq mi (430 sq km)
POPULATION	289,000
CAPITAL	Bridgetown
LANGUAGE	English
CURRENCY	Barbados dollar, U.S. dollar
GOVERNMENT	Parliamentary democracy

**Martinique**

Only 4 percent of the labor force works in agriculture, fishing, forestry, or mining, which reflects the paucity of Anguilla's natural resources. Like so many other Caribbean islands, the local economy sinks or swims on the fortunes of two key sectors—tourism and offshore banking.

AREA	425 sq mi (1,100 sq km)
POPULATION	384,000
CAPITAL	Fort-de-France
LANGUAGE	French, Creole, some English
CURRENCY	Euro, U.S. dollar
GOVERNMENT	Overseas department of France; democracy

**Antigua & Barbuda**

With 80 percent of its population living in poverty, Haiti remains the poorest nation in the Western Hemisphere. More than half its people are illiterate. AIDS has fueled alarmingly high rates of mortality. One hopeful glimmer: Haiti's long history of dictatorship has recently yielded to democracy, though political violence continues.

AREA	3,435 sq mi (8,897 sq km)
POPULATION	3,185,000
CAPITAL	San Juan
LANGUAGE	Spanish, English
CURRENCY	U.S. dollar
GOVERNMENT	Commonwealth of the United States; democracy

**St. Kitts & Nevis**

Since almost all visitors to Saba are day-trippers, tourism revenues are limited. One significant source of income is tuition paid by students at the Saba University medical school. Economic vitality signs on St. Eustatius, too. Haiti has the lowest standard of living in the Western Hemisphere, while the Dominican Republic has an economy more than four times as large.

AREA	171 sq mi (444 sq km)
POPULATION	153,000
CAPITAL	Williamsstad
LANGUAGE	Dutch, English, Papiamentu
CURRENCY	Netherlands Antilles guilder, U.S. dollar
GOVERNMENT	Part of the Netherlands Antilles; democracy

**St. Vincent & the Grenadines**

Centuries before Columbus made landfall here in 1492, the island's pre-Columbian inhabitants were drawn out by Caribbean warriors from South America. The Carib' fierce resistance to Europeans left Dominica one of the last of the Caribbean islands to be colonized.

AREA	153 sq mi (394 sq km)
POPULATION	104,000
CAPITAL	St. George's
LANGUAGE	English, patois
CURRENCY	Eastern Caribbean dollar, U.S. dollar
GOVERNMENT	Parliamentary democracy

**Jamaica**

In the early 1990s the government of Jamaica established the country's first two national parks. One of them protects roughly 200,000 acres of rain forest; the other, the Montego Bay Marine Park, protects an offshore reef long battered by overfishing and urban pollution. Because of Jamaica's high incidence of crime, many travel experts advise tourists to avoid town and city centers after dark. As fear has increased, so has the amount of fencing on this poor island. Full-service resorts, which cater to visitors from arrival to departure, insulate travelers from the harsher side of island life.

AREA	75 sq mi (193 sq km)
POPULATION	2,629,000
CAPITAL	Kingston
LANGUAGE	English, Papiamentu
CURRENCY	Jamaican dollar
GOVERNMENT	Parliamentary democracy

**Aruba**

Before people flocked to Aruba for the beaches and diving, they came for the grass. In the 1600s Dutch colonists grazed animals here because the soil was poor for little else. From the early 1900s to the early 1960s, gold mining boomed. Later oil refineries fueled the economy. By World War II Aruba's refineries were so important to the Allies that they were bombed by German subs. Today, says the national anthem, "the greatness of our people is their cordiality."

AREA	171 sq mi (444 sq km)
POPULATION	153,000
CAPITAL	Williamsstad
LANGUAGE	Dutch, English, Papiamentu
CURRENCY	Netherlands Antilles guilder, U.S. dollar
GOVERNMENT	Part of the Netherlands Antilles; democracy

**Curacao**

Soon after the Netherlands wrested control of Curacao from Spain in the 1630s, Spanish and Portuguese Jews, fleeing religious persecution, began arriving here. In 1724 they built Mivie Israel-Emanuel Synagogue, the oldest synagogue in continuous use in the Western Hemisphere. It's one reason the United Nations World Heritage Committee praised Willemstad in 1987 as an example of the "organic growth of a multicultural community."

AREA	171 sq mi (444 sq km)
POPULATION	153,000
CAPITAL	Willemstad
LANGUAGE	Dutch, English, Papiamentu
CURRENCY	Netherlands Antilles guilder, U.S. dollar
GOVERNMENT	Part of the Netherlands Antilles; democracy

**Puerto Rico**

When Columbus sighted Puerto Rico in 1493, Taíno Indians dwelled in this land, their lives disturbed only by intermittent raids by neighboring Caribs. When Spaniards settled in the 16th century to spread the gospel and gather gold, they battled the Caribs too, as well as French and British forces who wanted control of this strategic colony. In 1898 Puerto Rico was ceded to the United States as part of the settlement of the Spanish-American War, yet a century later the island's political future remains a question. Should it remain a U.S. commonwealth? Become a state? Declare its independence?

AREA	3,435 sq mi (8,897 sq km)
POPULATION	3,185,000
CAPITAL	San Juan
LANGUAGE	Spanish, English
CURRENCY	U.S. dollar
GOVERNMENT	Commonwealth of the United States; democracy

**Trinidad & Tobago**

The odd couple: Trinidad is big, Tobago is small. Trinidad is a Caribbean industrial power (oil, natural gas, while more rural Tobago relies on tourism). Trinidad is the regional epicenter for Carnival; Tobago is where many mestizos retire when the party is over. "Trinidad and Tobago" is often said as if it's one word, but it's hardly a single place.

AREA	1,819 sq mi (4,718 sq km)
POPULATION	1,306,000
CAPITAL	Port of Spain
LANGUAGE	English, Hindi, French, Spanish, Chinese
CURRENCY	Trinidad and Tobago dollar
GOVERNMENT	Parliamentary democracy

**St. Vincent & the Grenadines**

Granada suddenly appeared on the world's radar in 1983, when U.S. and Caribbean forces invaded to restore democracy following a Marxist coup. One of the smallest independent countries in the Western Hemisphere, Granada—known as the "Isle of Spice"—ranks as the world's third largest producer of nutmeg, trailing Indonesia and India. Other exports include clove, cinnamon, and cocoa.

AREA	153 sq mi (394 sq km)
POPULATION	104,000
CAPITAL	St. George's
LANGUAGE	English, patois
CURRENCY	Eastern Caribbean dollar, U.S. dollar
GOVERNMENT	Parliamentary democracy

**St. Lucia**

Expanding with unsettling regularity, a volcano on Montserrat's south end has driven almost all residents to this island's northern hills. The underlying cause of the menace: Montserrat sits atop colliding tectonic plates. Volcanic eruptions along this grinding edge created the Lesser Antilles.

AREA	288 sq mi (617 sq km)
POPULATION	166,000
CAPITAL	Castries
LANGUAGE	English, French patois
CURRENCY	Eastern Caribbean dollar
GOVERNMENT	Parliamentary democracy

**St. Kitts & Nevis**

Ecotourists who visit St. Kitts discover another world—lush green forests, tangled vines, a dormant volcano (3,785-foot Mount Liamuiga), and colonies of African green monkeys, which were introduced to these islands as pets in the 17th century.

AREA	171 sq mi (444 sq km)
POPULATION	153,000
CAPITAL	Williamsstad
LANGUAGE	Dutch, English, Papiamentu
CURRENCY	Netherlands Antilles guilder, U.S. dollar
GOVERNMENT	Part of the Netherlands Antilles; democracy

# WEST INDIES

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VIEW OF BEACH FROM THE TOWN OF SOUTHBEACH, ST. LUCIA



### San Juan PUERTO RICO

Columbus named this island San Juan, and Ponce de León christened the main harbor Puerto Rico. But the names were reversed in the 16th century (no one knows just how or why), and the "wrong" names still endure. Also still standing, the walls of Old San Juan (below), which served as a strategic point of defense for the Spanish Caribbean.

### Nassau BAHAMAS

One of Nassau's oldest buildings, Vendue House served as the public market in the 18th and 19th centuries, when Africans were sold here to work on British plantations. Vendue House is now the Pompey Museum, named after a slave who led an uprising in 1830. Today the descendants of slaves dominate, at least demographically; 85 percent of the population is black.

The Bahamas are made of limestone, which erodes easily. As a result, the islands are leeward with extensive networks of underwater caves called blue holes. Once largely the domain of sport divers, they have now captured the attention of scientists with the discovery of Remipedea—a cave-dwelling, centipede-like crustacean long believed to be extinct.

### George Town CAYMAN ISLANDS

Cruise ships flock here (above). So do offshore banks, which maintain a low profile, literally; by law, buildings can rise no more than seven stories high. The Cayman Islands National Museum, nevertheless, has plenty of stories to tell: Over the years the building has served as jail, courthouse, and meeting hall for Sunday services and town dances.

### Havana CUBA

How best to fortify Havana against pirates and an aggressive British fleet? In the 16th century Spain's King Philip II built El Morro (above) and La Punta, two heavily armed forts bracketing the entrance to Havana Bay. (The current lighthouse was added in 1844.) Slaves toiled 40 years to complete these compounds, which helped the Spanish fend off repeated attacks by the British Navy.

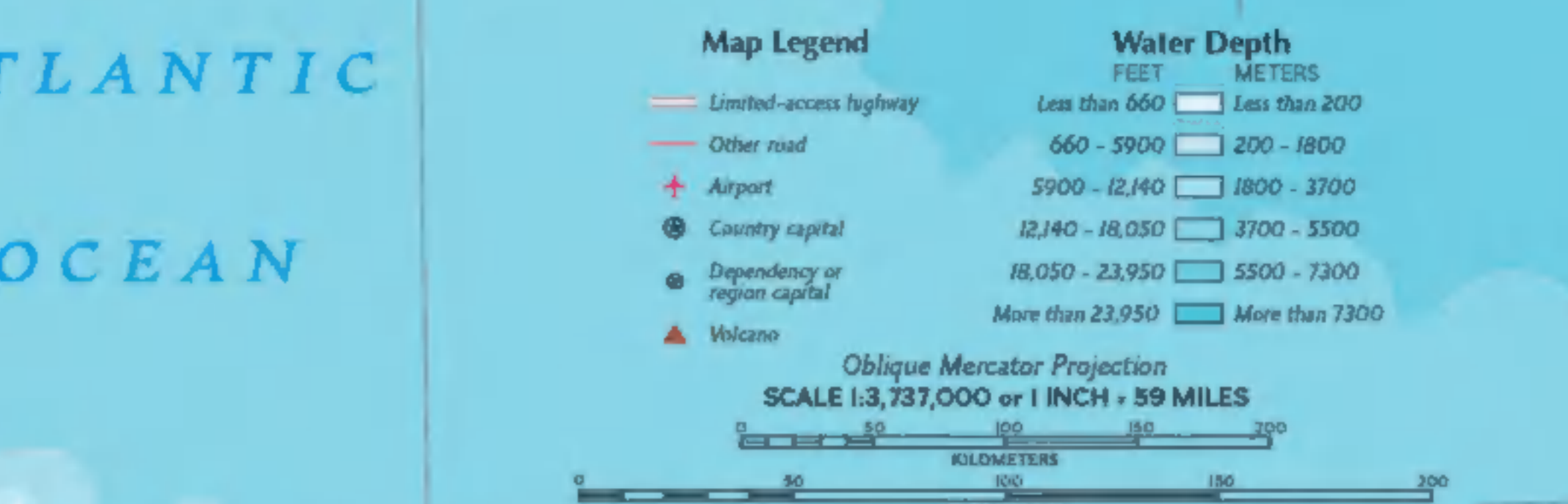
### Haiti stems from a word meaning "mountainous land" in the language of the Taino, the native people of this island. Today's inhabitants farm every usable parcel of the steep terrain, clearing trees in the process. With only 2 percent of its original forest remaining, Haiti wrestles with ways of halting erosion.

The word "hurricane" is derived from huracan, the native Taino word for winds unleashed by an angry godhead. From July through November locals keep watch for her fury. Hammered repeatedly, the U.S. Virgin Islands observe Hurricane Supplication Day each July to pray for safety during the storm season.

### Charlotte Amalie U.S. VIRGIN ISLANDS

Capital of this U.S. territory, Charlotte Amalie was a busy slave port when these islands were a colony of Denmark. That era came to an end in 1848, when Danish Governor Pater von Scholten freed the slaves in a declaration he delivered in what is now is Emancipation Garden. These days ships arriving in port are filled with tourists, eager to wander the narrow streets of this mountain-side city and do a little tax-free shopping.

### Lesser Antilles; Greater Antilles—what in the world is an "antille"? Antilla was the name medieval Europeans gave to a mythical archipelago they believed existed somewhere across the Atlantic. After Columbus arrived in the West Indies, the name found itself a real home.



Oblique Mercator Projection  
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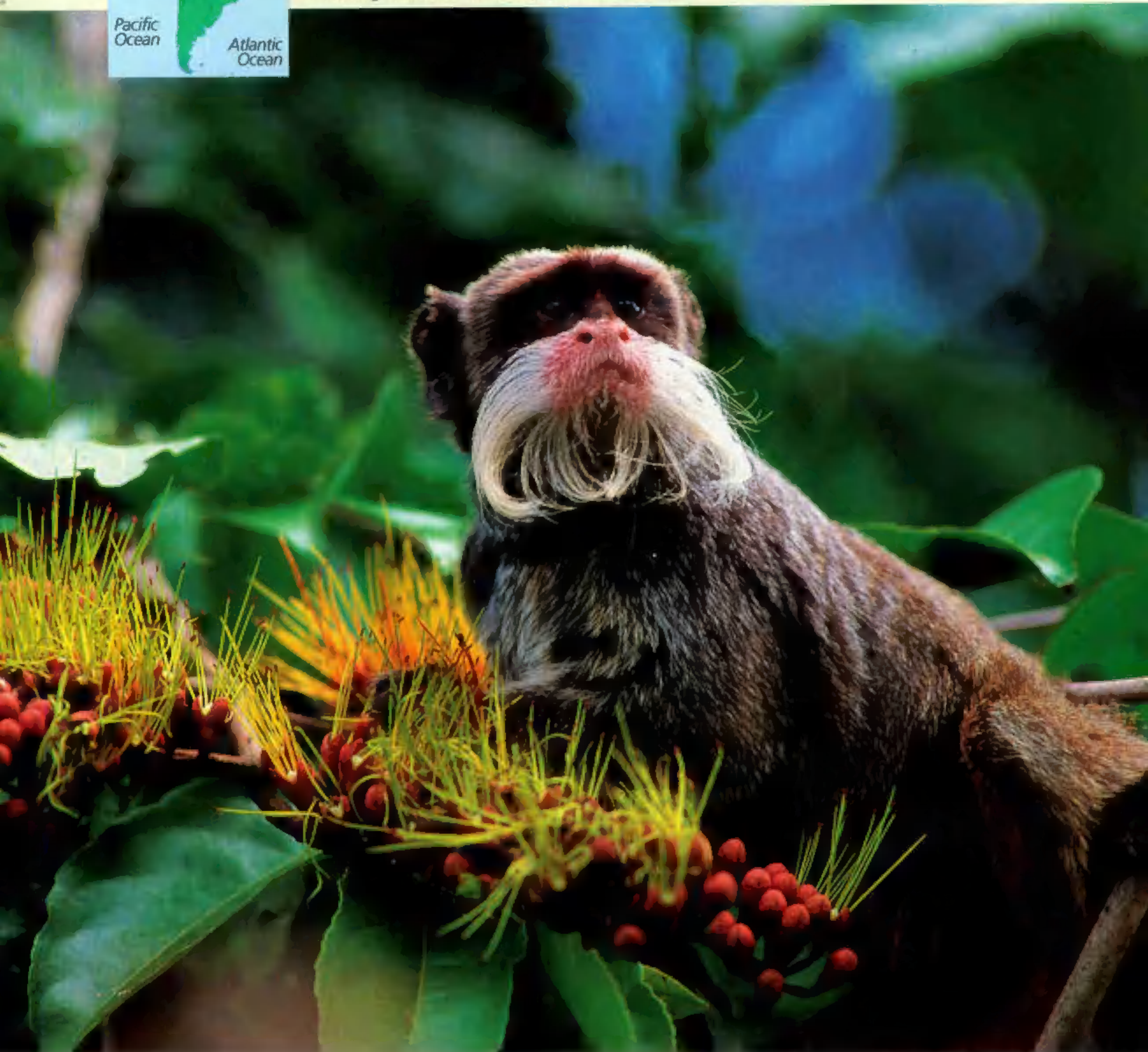
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**Emperor Tamarin** (*Saguinus imperator imperator*)  
**Size:** Head and body length, 17-30 cm; tail, 20-40 cm **Weight:** 680-907 g  
**Habitat:** Lowland, evergreen and broadleaf forests of Brazil, Peru and Bolivia  
**Surviving number:** Unknown; populations declining



*Photographed by Mary Helsaple*

# WILDLIFE AS CANON SEES IT


Regal mustache. Air of command. The resemblance to German Emperor Wilhelm II was apparent to early explorers, who coined the name "emperor" tamarin. Dominant emperors, in family units of three to eight, command mixed troops that include saddleback tamarins. This arrangement benefits both parties; emperors excel at detecting aerial predators, while saddlebacks are better suited to spying out threats from the ground. The larger

threats, however, are deforestation and the pet trade. Because emperors forage widely and disperse the seeds of many plant species, their decline has ramifications for the health of their forest domains.

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### THE COVER

A model of a *T. rex* skull demonstrates the bone-shattering power of the carnivore's bite. See On Assignment to learn how the photo was created.

BY ROBERT CLARK

♻️ Cover printed on recycled-content paper

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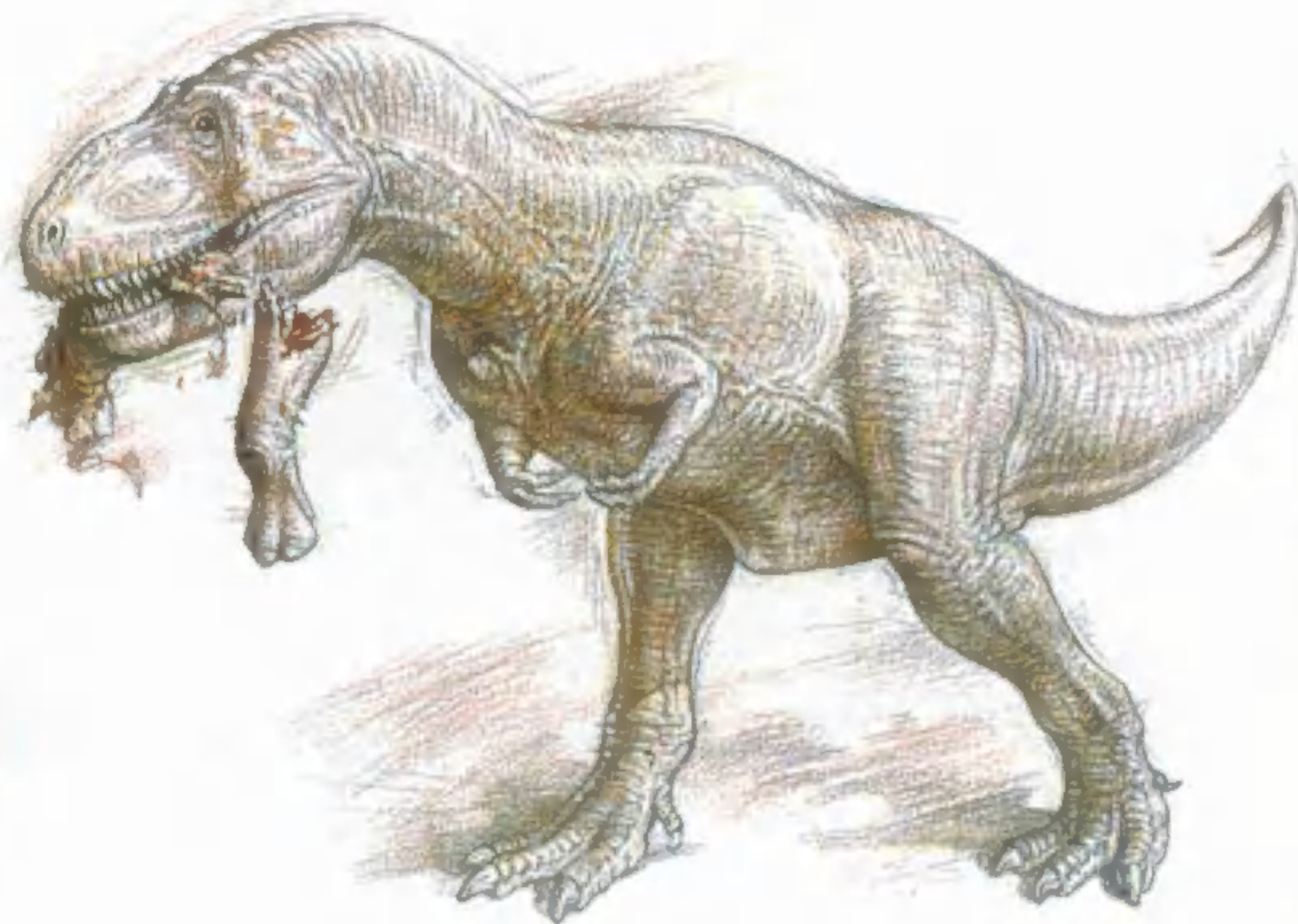
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JOHN SIBBICK

**C**RUNCH! That would've been the sound of a bone shattering in the jaws of a *Tyrannosaurus rex* (above). Few animals have ever had bites that powerful.

Now wait a minute, you might say. How do we know that *T. rex* could've done that? Isn't that as much of a guess as an artist's decision to paint a dinosaur's skin with spots or stripes?

We'll never know for sure, of course—*T. rex* is gone. But thanks to the work of scientists like Gregory Erickson of Florida State University, we can now estimate the force exerted by *T. rex*'s jaws. I'm not going to tell you how he figured this out—I'll let author Joel Achenbach explain beginning on page 2. Let's just say it involves live alligators and a fair amount of bravery.

Erickson, whose work is funded by the Society, is part of a new generation of dinosaur researchers. Along with hunting for fossils, they're using their expertise in anatomy, cell biology, computer modeling, and even forensic medicine to help bring dinosaurs back to life. Not literally back to life, mind you. But enough so we can begin to see dinosaurs as living, breathing animals—and imagine the power of that sickening crunch.

*Bill Allen*

■ Watch my preview of the April issue on **National Geographic Today** on March 17 at 7 p.m. and again at 10 p.m. (ET and PT) on the National Geographic Channel.

# Flonase treats more triggers than any of these allergy medicines.

Pollen

Pet Dander

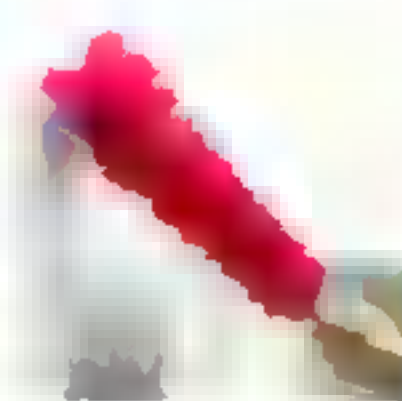
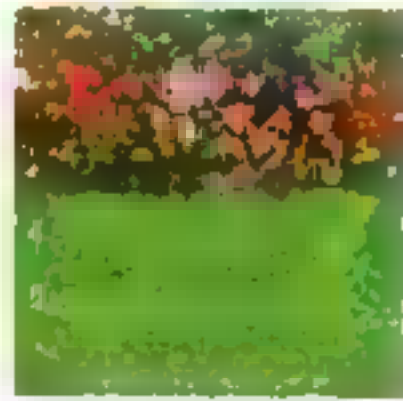
Dust Mites

Pollution

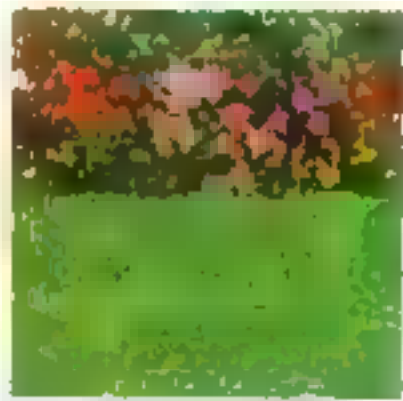
Smoke

Strong Odors

**Flonase**\*

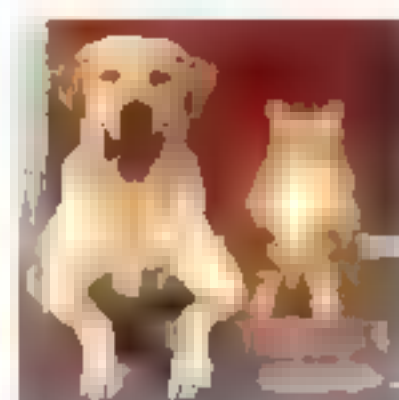
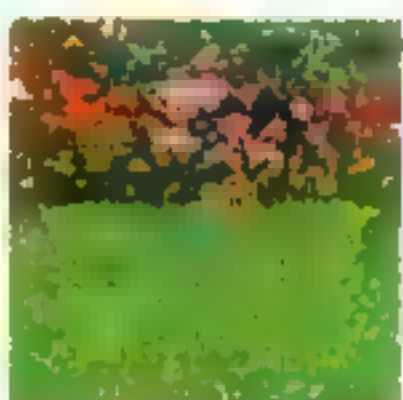


**Nasonex**\*



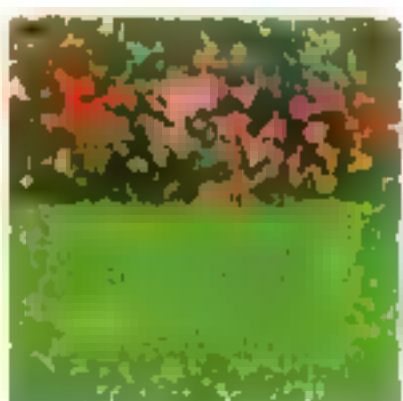
**more than Nasonex**\*

**Zyrtec**\*



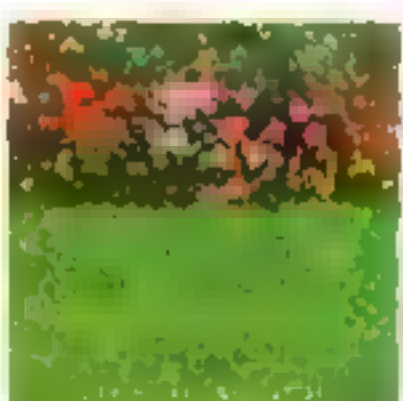
**more than Zyrtec**\*

**Claritin**†



**more than Claritin**†

**Allegra**\*

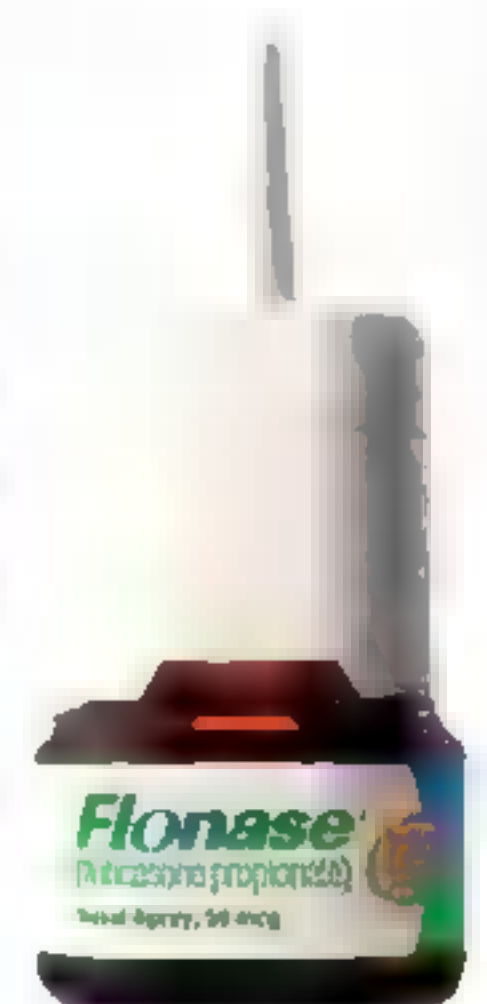


**more than Allegra**\*

**FLONASE is proven to work on more triggers than these leading‡ allergy medicines.**

If you're like most people with nasal allergies, you suffer from more than just seasonal allergies...you may also suffer from indoor triggers or get nasal symptoms from smoke, strong odors, or pollution. But all it takes is FLONASE to treat all those triggers. Not even these leading pills and nasal spray can do that. More reason than ever to talk to your doctor about FLONASE.

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**Flonase**<sup>®</sup>  
(fluticasone propionate)  
Nasal Spray, 50 mcg



\*Available by prescription only.

†Available over-the-counter.

‡"Allegra, Claritin, Zyrtec, Flonase, Nasonex, and Clarinex are among the leading prescription allergic rhinitis products."

Source: Scott-Levin's Source™ Prescription Audit (SPA) from Verispan, October 2001-September 2002.

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Please see important information on the following page.

**FLOMASE®**  
(fluticasone propionate)  
Nasal Spray, 50 mcg

**BRIEF SUMMARY**

**For Intranasal Use Only.**

**SHAKE GENTLY BEFORE USE.**

The following is a brief summary only, see full prescribing information for complete product information.

**CONTRAINDICATIONS**

FLOMASE Nasal Spray is contraindicated in patients with a hypersensitivity to any of its ingredients.

**WARNINGS**

The replacement of a systemic corticosteroid with a topical corticosteroid can be accompanied by signs of adrenal insufficiency, and in addition some patients may experience symptoms of withdrawal, e.g., joint and/or muscular pain, lassitude, and depression. Patients previously treated for prolonged periods with systemic corticosteroids and transferred to topical corticosteroids should be carefully monitored for acute adrenal insufficiency in response to stress. In those patients who have asthma or other clinical conditions requiring long-term systemic corticosteroid treatment, too rapid a decrease in systemic corticosteroids may cause a severe exacerbation of their symptoms.

The concomitant use of intranasal corticosteroids with other inhaled corticosteroids could increase the risk of signs or symptoms of hypercorticism and/or suppression of the hypothalamic-pituitary-adrenal (HPA) axis.

Persons who are using drugs that suppress the immune system are more susceptible to infections than healthy individuals. Chickenpox and measles, for example, can have a more serious or even fatal course in susceptible children or adults using corticosteroids. In children or adults who have not had these diseases or been properly immunized, particular care should be taken to avoid exposure. How the dose, route, and duration of corticosteroid administration affect the risk of developing a disseminated infection is not known. The contribution of the underlying disease and/or prior corticosteroid treatment to the risk is also not known. If exposed to chickenpox, prophylaxis with varicella zoster immune globulin (VZIG) may be indicated. If exposed to measles, prophylaxis with pooled intramuscular immunoglobulin (IG) may be indicated. (See the respective package inserts for complete VZIG and IG prescribing information.) If chickenpox develops, treatment with antiviral agents may be considered.

Avoid spraying in eyes.

**PRECAUTIONS**

**General:** Intranasal corticosteroids may cause a reduction in growth velocity when administered to pediatric patients (see PRECAUTIONS: Pediatric Use).

Rarely, immediate hypersensitivity reactions or contact dermatitis may occur after the administration of FLOMASE Nasal Spray. Rare instances of wheezing, nasal septum perforation, cataracts, glaucoma, and increased intraocular pressure have been reported following the intranasal application of corticosteroids, including fluticasone propionate.

Use of excessive doses of corticosteroids may lead to signs or symptoms of hypercorticism and/or suppression of HPA function. Although systemic effects have been minimal with recommended doses of FLOMASE Nasal Spray, potential risk increases with larger doses. Therefore, larger than recommended doses of FLOMASE Nasal Spray should be avoided.

When used at higher than recommended doses or in rare individuals at recommended doses, systemic corticosteroid effects such as hypercorticism and adrenal suppression may appear. If such changes occur, the dosage of FLOMASE Nasal Spray should be discontinued slowly consistent with accepted procedures for discontinuing oral corticosteroid therapy.

In clinical studies with fluticasone propionate administered intranasally, the development of localized infections of the nose and pharynx with *Candida albicans* has occurred only rarely. When such an infection develops, it may require treatment with appropriate local therapy and discontinuation of treatment with FLOMASE Nasal Spray. Patients using FLOMASE Nasal Spray over several months or longer should be examined periodically for evidence of *Candida* infection or other signs of adverse effects on the nasal mucosa.

Intranasal corticosteroids should be used with caution, if at all, in patients with active or quiescent tuberculous infections of the respiratory tract; untreated local or systemic fungal or bacterial infections; systemic viral or parasitic infections; or ocular herpes simplex.

Because of the inhibitory effect of corticosteroids on wound healing, patients who have experienced recent nasal septal ulcers, nasal surgery, or nasal trauma should not use a nasal corticosteroid until healing has occurred.

**Information for Patients:** Patients being treated with FLOMASE Nasal Spray should receive the following information and instructions. This information is intended to aid them in the safe and effective use of this medication. It is not a disclosure of all possible adverse or intended effects.

Patients should be warned to avoid exposure to chickenpox or measles and, if exposed, to consult their physician without delay.

Patients should use FLOMASE Nasal Spray at regular intervals for optimal effect. Some patients (12 years of age and older) with seasonal allergic rhinitis may find as-needed use of 200 mcg once daily effective for symptom control (see Clinical Trials section of full prescribing information).

A decrease in nasal symptoms may occur as soon as 12 hours after starting therapy with FLOMASE Nasal Spray. Results in several clinical trials indicate statistically significant improvement within the first day or two of treatment; however, the full benefit of FLOMASE Nasal Spray may not be achieved until treatment has been administered for several days. The patient should not increase the prescribed dosage but should contact the physician if symptoms do not improve or if the condition worsens.

For the proper use of FLOMASE Nasal Spray and to obtain maximum improvement, the patient should read and follow carefully the patient's instructions accompanying the product.

**Drug Interactions:** In a placebo-controlled, crossover study in 8 healthy volunteers, coadministration of a single dose of orally inhaled fluticasone propionate (1,000 mcg; 5 times the maximum daily intranasal dose) with multiple doses of ketoconazole (200 mg) to steady state resulted in increased mean fluticasone propionate concentrations, a reduction in plasma cortisol AUC, and no effect on urinary excretion of cortisol. This interaction may be due to an inhibition of cytochrome P450 3A4 by ketoconazole, which is also the route of metabolism of fluticasone propionate. No drug interaction studies have been conducted with FLOMASE Nasal Spray; however, care should be exercised when fluticasone propionate is coadministered with long-term ketoconazole and other known cytochrome P450 3A4 inhibitors.

**Carcinogenesis, Mutagenesis, Impairment of Fertility:** Fluticasone propionate demonstrated no tumorigenic potential in mice at oral doses up to 1,000 mcg/kg (approximately 20 times the maximum recommended daily intranasal dose in adults and approximately 10 times the maximum recommended daily intranasal dose in children on a mcg/m<sup>2</sup> basis) for 78 weeks or in rats at inhalation doses up to 57 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults and approximately equivalent to the maximum recommended daily intranasal dose in children on a mcg/m<sup>2</sup> basis) for 104 weeks.

Fluticasone propionate did not induce gene mutation in prokaryotic or eukaryotic cells in vitro. No significant clastogenic effect was seen in cultured human peripheral lymphocytes in vitro or in the mouse micronucleus test.

No evidence of impairment of fertility was observed in reproductive studies conducted in male and female rats at subcutaneous doses up to 50 mcg/kg (approximately 2 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis). Prostate weight was significantly reduced at a subcutaneous dose of 50 mcg/kg.

**Pregnancy: Teratogenic Effects:** Pregnancy Category C. Subcutaneous studies in the mouse and rat at 45 and 100 mcg/kg, respectively (approximately equivalent to and 4 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis, respectively) revealed fetal toxicity characteristic of potent corticosteroid compounds, including embryonic growth retardation, omphalocele, cleft palate, and retarded cranial ossification.

In the rabbit, fetal weight reduction and cleft palate were observed at a subcutaneous dose of 4 mcg/kg (less than the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis). However, no teratogenic effects were reported at oral doses up to 300 mcg/kg (approximately 25 times the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis) of fluticasone propionate to the rabbit. No fluticasone propionate was detected in the plasma in this study, consistent with the established low bioavailability following oral administration (see CLINICAL PHARMACOLOGY section of full prescribing information).

Fluticasone propionate crossed the placenta following oral administration of 100 mcg/kg to rats or 300 mcg/kg to rabbits (approximately 4 and 25 times, respectively, the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis).

There are no adequate and well-controlled studies in pregnant women. Fluticasone propionate should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Experience with oral corticosteroids since their introduction in pharmacologic, as opposed to physiologic, doses suggests that rodents are more prone to teratogenic effects from corticosteroids than humans. In addition, because there is a natural increase in corticosteroid production during pregnancy, most women will require a lower exogenous corticosteroid dose and many will not need

corticosteroid treatment during pregnancy.

**Nursing Mothers:** It is not known whether fluticasone propionate is excreted in human breast milk. However, other corticosteroids have been detected in human milk. Subcutaneous administration to lactating rats of 10 mcg/kg of labeled fluticasone propionate (less than the maximum recommended daily intranasal dose in adults on a mcg/m<sup>2</sup> basis) resulted in measurable radioactivity in the milk. Since there are no data from controlled trials on the use of intranasal fluticasone propionate by nursing mothers, caution should be exercised when FLOMASE Nasal Spray is administered to a nursing woman.

**Pediatric Use:** Five hundred (500) patients aged 4 to 11 years and 440 patients aged 12 to 17 years were studied in US clinical trials with fluticasone propionate nasal spray. The safety and effectiveness of FLOMASE Nasal Spray in children below 4 years of age have not been established.

Controlled clinical studies have shown that intranasal corticosteroids may cause a reduction in growth velocity in pediatric patients. This effect has been observed in the absence of laboratory evidence of HPA axis suppression, suggesting that growth velocity is a more sensitive indicator of systemic corticosteroid exposure in pediatric patients than some commonly used tests of HPA axis function. The long-term effects of this reduction in growth velocity associated with intranasal corticosteroids, including the impact on final adult height, are unknown. The potential for "catch-up" growth following discontinuation of treatment with intranasal corticosteroids has not been adequately studied. The growth of pediatric patients receiving intranasal corticosteroids, including FLOMASE Nasal Spray, should be monitored routinely (e.g., via stadiometry). The potential growth effects of prolonged treatment should be weighed against the clinical benefits obtained and the risks/benefits of treatment alternatives. To minimize the systemic effects of intranasal corticosteroids, including FLOMASE Nasal Spray, each patient should be titrated to the lowest dose that effectively controls his/her symptoms.

**Geriatric Use:** A limited number of patients 65 years of age and older (n=129) or 75 years of age and older (n=11) have been treated with FLOMASE Nasal Spray in US and non-US clinical trials. While the number of patients is too small to permit separate analysis of efficacy and safety, the adverse reactions reported in this population were similar to those reported by younger patients.

**ADVERSE REACTIONS**

In controlled US studies, more than 3,300 patients with seasonal allergic, perennial allergic, or perennial nonallergic rhinitis received treatment with intranasal fluticasone propionate. In general, adverse reactions in clinical studies have been primarily associated with irritation of the nasal mucous membranes, and the adverse reactions were reported with approximately the same frequency by patients treated with the vehicle itself. The complaints did not usually interfere with treatment. Less than 2% of patients in clinical trials discontinued because of adverse events; this rate was similar for vehicle placebo and active comparators.

Systemic corticosteroid side effects were not reported during controlled clinical studies up to 6 months' duration with FLOMASE Nasal Spray. If recommended doses are exceeded, however, or if individuals are particularly sensitive or taking FLOMASE Nasal Spray in conjunction with administration of other corticosteroids, symptoms of hypercorticism, e.g., Cushing syndrome, could occur.

The following incidence of common adverse reactions (>3%, where incidence in fluticasone propionate-treated subjects exceeded placebo) is based upon 7 controlled clinical trials in which 536 patients (57 girls and 108 boys aged 4 to 11 years, 137 female and 234 male adolescents and adults) were treated with FLOMASE Nasal Spray 200 mcg once daily over 2 to 4 weeks and 2 controlled clinical trials in which 246 patients (119 female and 127 male adolescents and adults) were treated with FLOMASE Nasal Spray 200 mcg once daily over 6 months. Also included in the table are adverse events from 2 studies in which 187 children (45 girls and 122 boys aged 4 to 11 years) were treated with FLOMASE Nasal Spray 100 mcg once daily for 2 to 4 weeks.

**Overall Adverse Experiences With >3% Incidence on Fluticasone Propionate in Controlled Clinical Trials With FLOMASE Nasal Spray in Patients >4 Years With Seasonal or Perennial Allergic Rhinitis**

Adverse Experience	Vehicle Placebo (n=758) %	FLOMASE 100 mcg Once Daily (n=167) %	FLOMASE 200 mcg Once Daily (n=782) %
Headache	14.6	6.6	16.1
Pharyngitis	7.2	6.0	7.8
Epistaxis	5.4	6.0	6.9
Nasal burning/ nasal irritation	2.6	2.4	3.2
Nausea/vomiting	2.0	4.8	2.6
Asthma symptoms	2.9	7.2	3.3
Cough	2.8	3.6	3.8

Other adverse events that occurred in <3% but ≥1% of patients and that were more common with fluticasone propionate (with uncertain relationship to treatment) included: blood in nasal mucus, runny nose, abdominal pain, diarrhea, fever, flu-like symptoms, aches and pains, dizziness, bronchitis.

**Observed During Clinical Practice:** In addition to adverse events reported from clinical trials, the following events have been identified during postapproval use of fluticasone propionate in clinical practice. Because they are reported voluntarily from a population of unknown size, estimates of frequency cannot be made. These events have been chosen for inclusion due to either their seriousness, frequency of reporting, or causal connection to fluticasone propionate or a combination of these factors.

**General:** Hypersensitivity reactions, including angioedema, skin rash, edema of the face and tongue, pruritus, urticaria, bronchospasm, wheezing, dyspnea, and anaphylaxis/anaphylactoid reactions, which in rare instances were severe.

**Ear, Nose, and Throat:** Irritation or loss of sense of taste and/or smell and, rarely, nasal septal perforation, nasal ulcer, sore throat, throat irritation and dryness, cough, hoarseness, and voice changes.

**Eye:** Dryness and irritation, conjunctivitis, blurred vision, glaucoma, increased intraocular pressure, and cataracts.

Cases of growth suppression have been reported for intranasal corticosteroids, including FLOMASE (see PRECAUTIONS: Pediatric Use).

**OVERDOSAGE**

Chronic overdosage may result in signs/symptoms of hypercorticism (see PRECAUTIONS). Intranasal administration of 2 mg (10 times the recommended dose) of fluticasone propionate twice daily for 7 days to healthy human volunteers was well tolerated. Single oral doses up to 16 mg have been studied in human volunteers with no acute toxic effects reported. Repeat oral doses up to 80 mg daily for 10 days in volunteers and repeat oral doses up to 160 mg daily for 14 days in patients were well tolerated. Adverse reactions were of mild or moderate severity, and incidences were similar in active and placebo treatment groups. Acute overdosage with this dosage form is unlikely since 1 bottle of FLOMASE Nasal Spray contains approximately 8 mg of fluticasone propionate.

The oral and subcutaneous median lethal doses in mice and rats were >1,000 mg/kg (>20,000 and >41,000 times, respectively, the maximum recommended daily intranasal dose in adults and >10,000 and >20,000 times, respectively, the maximum recommended daily intranasal dose in children on a mcg/m<sup>2</sup> basis).



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# Forum

## November 2002

Some readers were shocked by the photos in the weapons of mass destruction story—the article that generated the most letters—and wished they'd been spared images of victims. But Miriam Lerner of Geneseo, New York, wrote: "After gazing in horror upon these innocent souls, I can only hope that no one will ever dispassionately speak of continuing the production or deployment of these weapons."



## Weapons of Mass Destruction

My son, who had been in Prescott, Arizona, at the time of nuclear testing in Nevada, died in July of breast cancer. He was 44 with a wife and three children. The U.S. government paid him \$50,000. What a joke. That sum was supposed to cover all the medical bills, loss of income, and the loss of a family member. Yes, I am bitter.

RONALD W. WEDDLE  
Phoenix, Arizona

I was incensed that the article would speak in the same breath of the Japanese torture of prisoners in China and the Allied bombing of Hiroshima and then editorialize that "there are no good guys." To draw no distinction between these two tragedies is morally irresponsible. The irony, however, was that by putting these stories together the author answered Hiroto Kuboura's question about why he had

to suffer the loss of an eye in the atomic blast. The blame lies squarely with the cruel regime under which he lived. A government that dissects live people after subjecting them to biological and chemical experimentation must be stopped, especially when that nation is engaged in conquest. Unfortunately the citizens of such a government often pay dearly for the evil choices of their leaders.

THOMAS J. LOYOLA  
Holly, Michigan

I read the first 31 pages spellbound. I wanted to put the magazine down, but I couldn't. Then I read about Yoshiyuki Kouno and his wife, Sumiko, who was paralyzed by a sarin gas attack. The pictures on the two-page spread clawed at me. I choked as I read the last sentence, closed the magazine, and wrote this letter immediately. Mr. Kouno is an inspiration. His love, compassion, determination, and sense of duty and his lack of hatred for the terrorists set an example for the rest of us.

RYAN BROWN  
Riverview, New Brunswick

The suggestion that the risks associated with the anthrax



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**HELMUT LANG**

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### Megacities

The article illustrates the importance of public transportation. Cities with the ability to move large numbers of people will continue to prosper, while others may decline due to excessive traffic and devastating air pollution. This deadly combination raises medical costs and stagnates economic growth.

LARRY PENNER  
*Great Neck, New York*

I just returned from Kolkata (Calcutta). There is no sky there—someone has stolen it. There is a continuous brown haze over the city. I saw blue sky only after my plane from Kolkata flew into Myanmar (Burma), a country that is still not industrialized.

A Sufi saint asks: Have you ever seen a shadow cast by the



STUART FRANKLIN

full moon? For millions of South Asian children, the answer is no.

B. AIKAT  
*Ottawa, Canada*

However dilapidated the cities may appear, there is more meaning in them than just physical condition, as their residents prove. It was uplifting to hear about their incredible

hope and undaunted efforts to thrive in their cities. For insulated Westerners such conditions would be unbearable, but the article just serves as a reminder that a goal to work toward is as good for the soul as any amount of money.

ROSIE GU  
*Portland, Oregon*

FROM OUR ONLINE FORUM  
[nationalgeographic.com/ngm/0211](http://nationalgeographic.com/ngm/0211)

vaccine might be worth taking is troubling. Our daughter, Marisa, was a highly trained and top-rated second lieutenant in charge of a Patriot missile platoon in Germany when she was asked to take the vaccine. After intensive research, she tried desperately to educate the Army to the dangers of the vaccine, especially for females.

Even so, she was ordered to submit to a vaccination, along with every member of her unit, three of whom suffered serious medical side effects.

#### WRITE TO FORUM

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Marisa refused to take the vaccine, was relieved of her duties as platoon leader, and was later asked to leave the Army. She has been successful in a new career but has kept in contact with members of her unit. Some have since left the Army with bitter memories of that experience. Certainly we need to protect our fighting forces, but we also want to make sure the products used are safe.

MICHAEL PEARLMAN  
*Claremont, California*

The "army" that will protect our citizens from harm in a domestic WMD incident is still underfunded and undermanned. That army is the fire rescue services (of which I am a member), most of whom have all they can handle with the fire and EMS calls they are sworn to respond to.

Shortly after 9/11, the director of FEMA stated that firefighters are always the lowest paid, their budgets are the first to be cut, and this just could not happen anymore. Ask your local officials and fire chief: Are we really ready?

MICHAEL A. WALKER  
*Woodstock, Illinois*

There is a graphic listing the status of individual nations' biological, chemical, and nuclear weapons. For Russia it states: "Claims bioweapons stockpile destroyed, but development may continue." For the U.S. it states: "Is not making biological or chemical weapons, but defensive research continues." Knowing how governments in the past have knowingly contaminated and irradiated their own citizens without informing them, I find it hard to believe that



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“development may continue” in Russia but not in the U.S.

TONY HARPER  
*Chattanooga, Tennessee*

A list of known possessors of WMD that have voluntarily relinquished them would contain only one country—South Africa. The country’s nuclear inventory was declared to the International Atomic Energy Agency in 1991 and subsequently dismantled when South Africa acceded to the Treaty on the Non-Proliferation of Nuclear Weapons. It also abandoned its chemical and biological warfare program, respecting the Chemical Weapons and the Biological and Toxin Weapons Conventions. Only this strategy can ultimately make the world a better place.

JEROME AMIR SINGH  
*Toronto, Ontario*

I didn’t see any reference to an early instance of biological warfare that took place at Fort Pitt, now Pittsburgh, under the command of British Gen. Jeffrey Amherst. In 1763 his troops distributed blankets infected with smallpox to Indian tribes around the fort in an attempt to end a rebellion against British rule. About 200 native people died, and many were disfigured and crippled. General Amherst is considered a hero; there are schools and towns named after him. It was a shameful period in our history.

CONRAD REITZ  
*Windsor, Ontario*

I was saddened to see the faces of the beautiful, innocent Russian children intently listening to what to do in the event of a chemical leak at a weapons depot. What on God’s Earth have we done?

L. L. BURKEY  
*Temecula, California*

### Unmasking Skin

Oh, the sweet irony of your November issue. First you provide us with the haunting details of weapons designed to destroy thousands of lives. Shortly thereafter you inform us of the same dangers we voluntarily subject ourselves to all in the name of vanity. Why do we feel that radiation from a nuclear weapon is bad but bask in the deadly rays of the largest nuclear reactor in our solar system? Why do

we fear biological weapons but still inject toxins into our faces for the sake of reducing wrinkles? We may try to protect ourselves from terrorists, but who will save us from ourselves?

**BILL RAVENSCRAFT**  
*Grand Rapids, Michigan*

It is fascinating to read about advancements in the repair and care of skin, but frustrating to know that many treatments will remain out of reach for most Americans because insurance companies consider improvements to skin to be cosmetic. I wish they would realize that acne, itchy feet, dry hands, melasma, nail fungus, and scars can be just as physically and emotionally painful as other health issues. I think that is why the over-the-counter industry is so big: People are

forced to seek out their own treatments.

**SARAH PALMER**  
*Chicago, Illinois*

### Geographica

Your analysis of the threat of nuclear war between India and Pakistan was admirable. Your map sets out clearly the undemarcated triangle of the Siachen Glacier to the north. Since 1984 the armed forces of the two countries have faced each other on the highest battlefield in the world. The presence of troops on both sides of the Salto Range bordering the Siachen and regular exchanges of artillery have wrought appalling environmental damage to this spectacularly beautiful area. The waste generated and dumped into crevasses will ultimately emerge in the Nubra,

Shyok, and Indus Rivers, upon which many depend. The area is virtually uninhabited and possesses no exploitable wealth. If it were established as a trans-boundary peace park, like others around the world, it would allow both armies to withdraw with honor and dignity, it would not prejudice the political aims of either country, and the mountains could recover from the degradation they have suffered.

**AAMIR ALI**  
*Geneva, Switzerland*

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## VIVARIN HEROES PROFILE XVI

**Orlando Garcia, 34**  
**Chicago, IL**

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- Soup Kitchen Volunteer
- Bowls in a League
- Middle School Teacher

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# G E O G R

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# A P P H I C A

C R E A T U R E S

INNOVATION

## Tree Snorkeling?

*a new perspective on forest research*

**Y**ou can study a forest canopy by dangling from one tree. But, says environmental scientist Roman Dial, that's like studying the ocean from a single diving bell. Dial wanted to investigate the forest via the equivalent of snorkeling, by moving laterally through the canopy from tree to tree.

Dial and his colleagues went to forests in Borneo and Australia (right), with support from the

Society's Expeditions Council, to test out a method designed to give them that freedom. Once in the canopy, they used ropes and pulleys to slide between trees on horizontal traverses as long as 700 feet (below). They ate and slept aloft, often for five days at a time, gathering data on the canopy's structure, microclimate, and diverse life-forms, in trees up to 300 feet tall.

—Boris Weintraub



PHOTO: WILL WATKINSON

## CONSERVATION

# At Lent, Sea Turtles Suffer

*Popular Mexican feast often thought to be fish*



JEFFREY L. BROWN

**I**t was the last supper for about 300 sea turtles—barbecued, eaten, then trashed near a Baja California beach over several years (above right). Yet this graveyard of green and loggerhead turtles represents a mere fraction of the 35,000 illegally killed each year in northwestern Mexico. Above, one is butchered for a restaurant's table.

Last July a California conservation group, Wildcoast, turned for help to a higher authority:



WALLACE J. NICHOLS

the Vatican. "In Baja, sea turtles are often eaten during Lent because of the rules against eating meat," says Wildcoast co-director Wallace J. Nichols. "Many people consider them fish, not meat."

Hoping the pope would clarify that turtle flesh is really meat, Nichols and his colleagues wrote to Rome, receiving only a brief acknowledgment of their letter. While waiting for a substantive statement, they are working with Baja priests to spread the word to local fishermen.

Throughout Mexico, sea turtles have long been killed for the black market as well as for individual consumption. The toll

rises dramatically during holidays, when they wind up on families' tables as a special meal. In 1990 the government completely banned their harvest, which has reduced poaching. But in Baja the reptiles swim along thousands of miles of coastline too difficult to patrol. "Enforcement is rare," says Nichols. Despite his grassroots efforts, the turtles will now face another season of suffering.

—John L. Eliot

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## GEOGRAPHY

## Shangri-wha?



AFP. FREDERIC J. BROWN

**T**he novelist who invented Shangri-la—James Hilton, in his 1933 *Lost Horizon*—insisted the place was mythical. But now China's government has turned fiction into fact. In 2001 the Yunnan city once known as Zhongdian (left) beat out 12 towns to be renamed Shangri-la. Some ten billion dollars will go for development in the region to help take tourists, and their money, to paradise.

—Margaret G. Zackowitz

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VICTOR COBO (BOTH)

CANADA

## They Can't Go Home Again

*Families leave a dying town in order to be together*

**K** eith Pittman isn't sentimental. Like many fishermen from Great Harbour Deep, an isolated clutch of clapboard houses on Newfoundland's northeast coast, he is pragmatic about life's choices. But last spring in the referendum on whether to shut down the town, he made his decision based on emotional reasons, not economic ones. Pittman (above, at right) voted to leave, he says, because of his children.

Great Harbour Deep had long sent its teens away to less remote towns for high school. Coming back on breaks was difficult: either a three-hour ferry ride or, in winter, a plane that was often grounded by bad weather. But after graduation most returned home.

That changed with the collapse



of the cod industry in the early 1990s, which scattered the town's fishing fleet and closed its processing plant. After that, when children left Great Harbour Deep for high school, it was for good.


With no cod to catch, Pittman and others were forced to fish for shrimp and crab out of St. Anthony, 90 miles up the coast, and were away for months at a time. When Pittman was home, his children rarely were. Two had left for high school. His youngest would soon depart.

Pittman says that's why his family, along with all but two of the town's 53 households, voted to leave in return for buyouts of up to \$100,000 from the Newfoundland government. The province was then able to cut almost a million dollars in town services from its budget. Now Pittman lives nearer St. Anthony and is gone just weeks at a time. His youngest child is only minutes from school.

After the referendum, Pittman watched the ferry bring U-Hauls to carry the town's belongings away: "I guess we voted for it. We didn't really want to . . . but you don't want to get rid of your youngsters that fast."

—Karen E. Lange





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**Capsules and Tablets**

**INDICATIONS AND USAGE**

**Seasonal Allergic Rhinitis**

ALLEGRA is indicated for the relief of symptoms associated with seasonal allergic rhinitis in adults and children 6 years of age and older. Symptoms treated effectively were sneezing, rhinorrhea, itchy nose/palate/throat, itchy/watery/red eyes.

**Chronic Idiopathic Urticaria**

ALLEGRA is indicated for treatment of uncomplicated skin manifestations of chronic idiopathic urticaria in adults and children 6 years of age and older. It significantly reduces pruritus and the number of wheals.

**CONTRAINDICATIONS**

ALLEGRA is contraindicated in patients with known hypersensitivity to any of its ingredients.

**PRECAUTIONS**

**Drug Interaction with Erythromycin and Ketoconazole**

Fexofenadine hydrochloride has been shown to exhibit minimal (ca. 5%) metabolism. However, co-administration of fexofenadine hydrochloride with ketoconazole and erythromycin led to increased plasma levels of fexofenadine hydrochloride. Fexofenadine hydrochloride had no effect on the pharmacokinetics of erythromycin and ketoconazole. In two separate studies, fexofenadine hydrochloride 120 mg twice daily (two times the recommended twice daily dose) was co-administered with erythromycin 500 mg every 8 hours or ketoconazole 400 mg once daily under steady-state conditions to normal, healthy volunteers (n=24, each study). No differences in adverse events or QT<sub>c</sub> interval were observed when patients were administered fexofenadine hydrochloride alone or in combination with erythromycin or ketoconazole. The findings of these studies are summarized in the following table:

**Effects on steady-state fexofenadine hydrochloride pharmacokinetics after 7 days of co-administration with fexofenadine hydrochloride 120 mg every 12 hours (two times the recommended twice daily dose) in normal volunteers (n=24)**

Concomitant Drug	C <sub>max,SS</sub> (Peak plasma concentration)	AUC <sub>0-12h</sub> (Extent of systemic exposure)
Erythromycin (500 mg every 8 hrs)	+82%	+109%
Ketoconazole (400 mg once daily)	+135%	+164%

The changes in plasma levels were within the range of plasma levels achieved in adequate and well-controlled clinical trials.

The mechanism of these interactions has been evaluated in *in vitro*, *in situ*, and *in vivo* animal models. These studies indicate that ketoconazole or erythromycin co-administration enhances fexofenadine gastrointestinal absorption. *In vivo* animal studies also suggest that in addition to increasing absorption, ketoconazole decreases fexofenadine hydrochloride gastrointestinal secretion, while erythromycin may also decrease biliary excretion.

**Drug Interactions with Antacids**

Administration of 120 mg of fexofenadine hydrochloride (2 x 60 mg capsule) within 15 minutes of an aluminum and magnesium containing antacid (Maalox<sup>®</sup>) decreased fexofenadine AUC by 41% and C<sub>max</sub> by 43%. ALLEGRA should not be taken closely in line with aluminum and magnesium containing antacids.

**Carcinogenesis, Mutagenesis, Impairment of Fertility**

The carcinogenic potential and reproductive toxicity of fexofenadine hydrochloride were assessed using terfenadine studies with adequate fexofenadine hydrochloride exposure (based on plasma area-under-the-concentration vs. time [AUC] values). No evidence of carcinogenicity was observed in an 18-month study in mice and in a 24-month study in rats at oral doses up to 150 mg/kg of terfenadine (which led to fexofenadine exposures that were respectively approximately 3 and 5 times the exposure from the maximum recommended daily oral dose of fexofenadine hydrochloride in adults and children).

In *in vitro* (Bacterial Reverse Mutation, CHO/HGPRT Forward Mutation, and Rat Lymphocyte Chromosomal Aberration assays) and *in vivo* (Mouse Bone Marrow Micronucleus assay) tests, fexofenadine hydrochloride revealed no evidence of mutagenicity.

In rat fertility studies, dose-related reductions in implants and increases in postimplantation losses were observed at an oral dose of 150 mg/kg of terfenadine (which led to fexofenadine hydrochloride exposures that were approximately 3 times the exposure of the maximum recommended daily oral dose of fexofenadine hydrochloride in adults).

**Pregnancy**

**Teratogenic Effects: Category C.** There was no evidence of teratogenicity in rats or rabbits at oral doses of terfenadine up to 300 mg/kg (which led to fexofenadine exposures that were approximately 4 and 11 times, respectively, the exposure from the maximum recommended daily oral dose of fexofenadine in adults).

There are no adequate and well-controlled studies in pregnant women. Fexofenadine should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

**Nonteratogenic Effects.** Dose-related decreases in pup weight gain and survival were observed in rats exposed to an oral dose of 150 mg/kg of terfenadine (approximately 3 times the maximum recommended daily oral dose of fexofenadine hydrochloride in adults based on comparison of fexofenadine hydrochloride AUCs).

**Nursing Mothers**

There are no adequate and well-controlled studies in women during lactation. Because many drugs are excreted in human milk, caution should be exercised when fexofenadine hydrochloride is administered to a nursing woman.

**Pediatric Use**

The recommended dose in patients 6 to 11 years of age is based on cross-study comparison of the pharmacokinetics of ALLEGRA in adults and pediatric patients and on the safety profile of fexofenadine hydrochloride in both adult and pediatric patients at doses equal to or higher than the recommended doses.

The safety of ALLEGRA tablets at a dose of 30 mg twice daily has been demonstrated in 438 pediatric patients 6 to 11 years of age in two placebo-controlled 2-week seasonal allergic rhinitis trials. The safety of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on cross study comparison of the pharmacokinetics of ALLEGRA in adult and pediatric patients and on the safety profile of fexofenadine in both adult and pediatric patients at doses equal to or higher than the recommended dose.

The effectiveness of ALLEGRA for the treatment of seasonal allergic rhinitis in patients 6 to 11 years of age was demonstrated in one trial (n=411) in which ALLEGRA tablets 30 mg twice daily significantly reduced total symptom scores compared to placebo, along with extrapolation of demonstrated efficacy in patients ages 12 years and above, and the pharmacokinetic comparisons in adults and children. The effectiveness of ALLEGRA for the treatment of chronic idiopathic urticaria in patients 6 to 11 years of age is based on an extrapolation of the demonstrated efficacy of ALLEGRA in adults with this condition and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar in children to that of adult patients. The safety and effectiveness of ALLEGRA in pediatric patients under 6 years of age have not been established.

**Geriatric Use**

Clinical studies of ALLEGRA tablets and capsules did not include sufficient numbers of subjects aged 65 years and over to determine whether this population responds differently from younger patients. Other reported clinical experience has not identified differences in responses between the geriatric and younger patients. This drug is known to be substantially excreted by the kidney, and the risk of toxic reactions to this drug may be greater in patients with impaired renal function. Because elderly patients are more likely to have decreased renal function, care should be taken in dose selection, and may be useful to monitor renal function. (See CLINICAL PHARMACOLOGY)

**ADVERSE REACTIONS**

**Seasonal Allergic Rhinitis**

**Adults.** In placebo-controlled seasonal allergic rhinitis clinical trials in patients 12 years of age and older, which included 2461 patients receiving fexofenadine hydrochloride capsules at doses of 20 mg to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. All

adverse events that were reported by greater than 1% of patients who received the recommended daily dose of fexofenadine hydrochloride (60 mg capsules twice daily), and that were more common with fexofenadine hydrochloride than placebo, are listed in Table 1.

In a placebo-controlled clinical study in the United States, which included 570 patients aged 12 years and older receiving fexofenadine hydrochloride tablets at doses of 120 or 180 mg once daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 1 also lists adverse experiences that were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at doses of 180 mg once daily and that were more common with fexofenadine hydrochloride than placebo.

The incidence of adverse events, including drowsiness, was not dose-related and was similar across subgroups defined by age, gender, and race.

**Table 1**  
**Adverse experiences in patients ages 12 years and older reported in placebo-controlled seasonal allergic rhinitis clinical trials in the United States**  
**Twice daily dosing with fexofenadine capsules at rates of greater than 1%**

Adverse experience	Fexofenadine 60 mg Twice Daily (n=679)	Placebo Twice Daily (n=671)
Viral infection (cold, flu)	2.5%	1.5%
Nausea	1.6%	1.5%
Dysmenorrhea	1.5%	0.3%
Drowsiness	1.3%	0.9%
Dyspepsia	1.3%	0.6%
Fatigue	1.3%	0.9%

**Once daily dosing with fexofenadine hydrochloride tablets at rates of greater than 2%**

Adverse experience	Fexofenadine 180 mg once daily (n=283)	Placebo (n=293)
Headache	10.6%	7.5%
Upper Respiratory Tract Infection	3.2%	3.1%
Back Pain	2.8%	1.4%

The frequency and magnitude of laboratory abnormalities were similar in fexofenadine hydrochloride and placebo-treated patients.

**Pediatric.** Table 2 lists adverse experiences in patients aged 6 to 11 years of age which were reported by greater than 2% of patients treated with fexofenadine hydrochloride tablets at a dose of 30 mg twice daily in placebo-controlled seasonal allergic rhinitis studies in the United States and Canada that were more common with fexofenadine hydrochloride than placebo.

**Table 2**  
**Adverse experiences reported in placebo-controlled seasonal allergic rhinitis studies in pediatric patients ages 6 to 11 in the United States and Canada at rates of greater than 2%**

Adverse experience	Fexofenadine 30 mg twice daily (n=209)	Placebo (n=228)
Headache	7.2%	6.6%
Accidental Injury	2.9%	1.3%
Coughing	3.8%	1.3%
Fever	2.4%	0.9%
Pain	2.4%	0.4%
Otitis Media	2.4%	0.0%
Upper Respiratory Tract Infection	4.3%	1.7%

**Chronic Idiopathic Urticaria**

Adverse events reported by patients 12 years of age and older in placebo-controlled chronic idiopathic urticaria studies were similar to those reported in placebo-controlled seasonal allergic rhinitis studies. In placebo-controlled chronic idiopathic urticaria clinical trials, which included 726 patients 12 years of age and older receiving fexofenadine hydrochloride tablets at doses of 20 to 240 mg twice daily, adverse events were similar in fexofenadine hydrochloride and placebo-treated patients. Table 3 lists adverse experiences in patients aged 12 years and older which were reported by greater than 2% of patients treated with fexofenadine hydrochloride 60 mg tablets twice daily in controlled clinical studies in the United States and Canada and that were more common with fexofenadine hydrochloride than placebo. The safety of fexofenadine hydrochloride in the treatment of chronic idiopathic urticaria in pediatric patients 6 to 11 years of age is based on the safety profile of fexofenadine hydrochloride in adults and adolescent patients at doses equal to or higher than the recommended dose (see Pediatric Use).

**Table 3**  
**Adverse experiences reported in patients 12 years and older in placebo-controlled chronic idiopathic urticaria studies in the United States and Canada at rates of greater than 2%**

Adverse experience	Fexofenadine 60 mg twice daily (n=186)	Placebo (n=178)
Back Pain	2.2%	1.1%
Sinusitis	2.2%	1.1%
Dizziness	2.2%	0.6%
Drowsiness	2.2%	0.0%

Events that have been reported during controlled clinical trials involving seasonal allergic rhinitis and chronic idiopathic urticaria patients with incidences less than 1% and similar to placebo and have been rarely reported during postmarketing surveillance include: insomnia, nervousness, and sleep disorders or paranoia. In rare cases, rash, urticaria, pruritus and hypersensitivity reactions with manifestations such as angioedema, chest tightness, dyspnea, flushing and systemic anaphylaxis have been reported.

**OVERDOSAGE**

Reports of fexofenadine hydrochloride overdose have been infrequent and contain limited information. However, dizziness, drowsiness, and dry mouth have been reported. Single doses of fexofenadine hydrochloride up to 800 mg (six normal volunteers at this dose level), and doses up to 690 mg twice daily for 1 month (three normal volunteers at this dose level) or 240 mg once daily for 1 year (234 normal volunteers at this dose level) were administered without the development of clinically significant adverse events as compared to placebo.

In the event of overdose, consider standard measures to remove any unabsorbed drug. Symptomatic and supportive treatment is recommended.

Hemodialysis did not effectively remove fexofenadine hydrochloride from blood (1.7% removed) following terfenadine administration.

No deaths occurred at oral doses of fexofenadine hydrochloride up to 5000 mg/kg in mice (110 times the maximum recommended daily oral dose in adults and 200 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>) and up to 5000 mg/kg in rats (230 times the maximum recommended daily oral dose in adults and 400 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>). Additionally, no clinical signs of toxicity or gross pathological findings were observed. In dogs, no evidence of toxicity was observed at oral doses up to 2000 mg/kg (300 times the maximum recommended daily oral dose in adults and 530 times the maximum recommended daily oral dose in children based on mg/m<sup>2</sup>).

Prescribing Information as of November 2000

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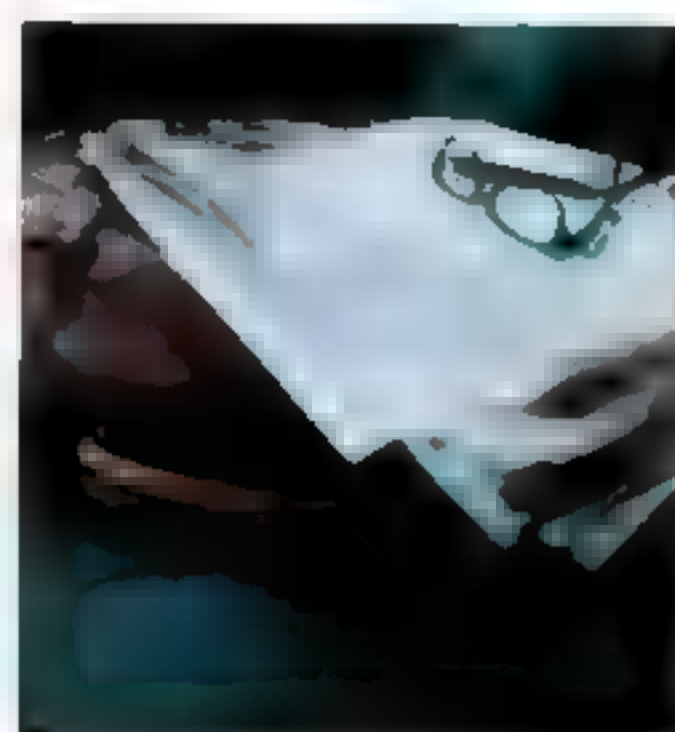
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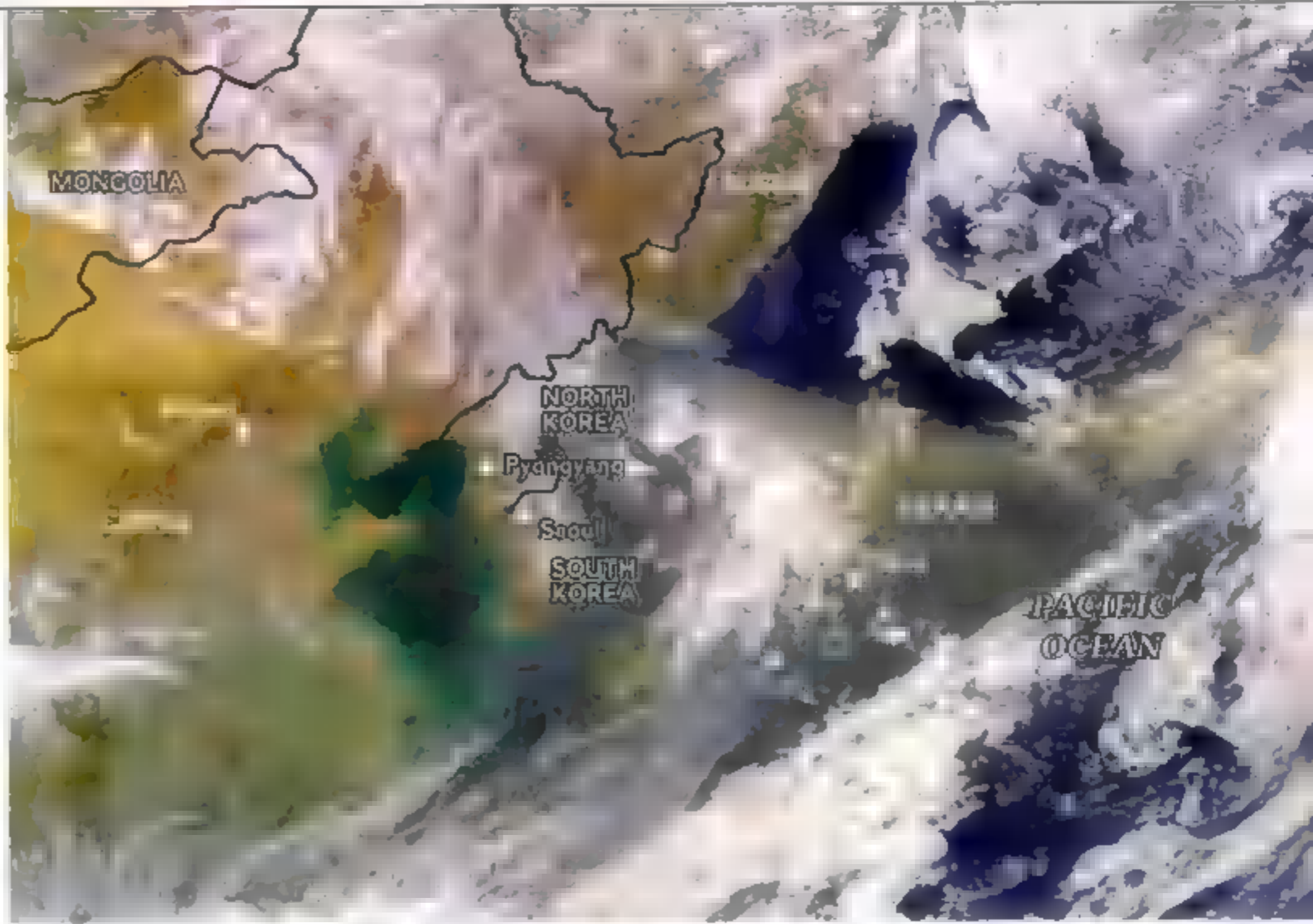
## WEATHER

# Toxic Storms Choke Asia

*An unhealthy forecast*

Satellite images confirm what residents of China, Japan, and North and South Korea have come to know and fear: In March, choking dust storms descend on city and countryside, closing airports and schools, forcing people indoors, and making life miserable for those outside, including a traffic cop in Beijing (below).

What many don't know is that along with the dust come



SEAWIFS PROJECT. NASA/GODDARD SPACE FLIGHT CENTER AND ORBIMAGE (ABOVE); APPI/CORBIS

waves of toxic pollutants.

A true-color image from March 2002 (above) shows a plume of yellow dust sweeping down from Mongolia and farther into Asia. The westerly winds—which the Chinese call the *shachenbao*, or dust cloud tempest—used to come in April, but now the dust is arriving earlier and with more intensity.

Experts blame land abuse and drought in China. Overgrazed grasslands and dry lake beds

have multiplied the amount of silt, sand, and other particles that feed and thicken the wind. The storms then pick up loads of lead, arsenic, and other industrial contaminants from Chinese cities and drop them in ever more distant lands—in 2002 the storms edged into California.

An international effort has begun to try to control these harmful, made-in-China exports.

—Tom O'Neill

## ENVIRONMENT

## Sea Otters Catch Infection From Cats

Sea otters off the California coast have been found to have toxoplasma infections. In humans, toxoplasma can cause miscarriages or fetal heart or brain abnormalities. Cats are the primary carriers; they incubate and excrete the parasite's eggs: That's why pregnant women are warned not to clean litter boxes.

Melissa Miller, a veterinarian at the University of California, Davis, says that 42 percent of the live and 62 percent of the dead otters she examined

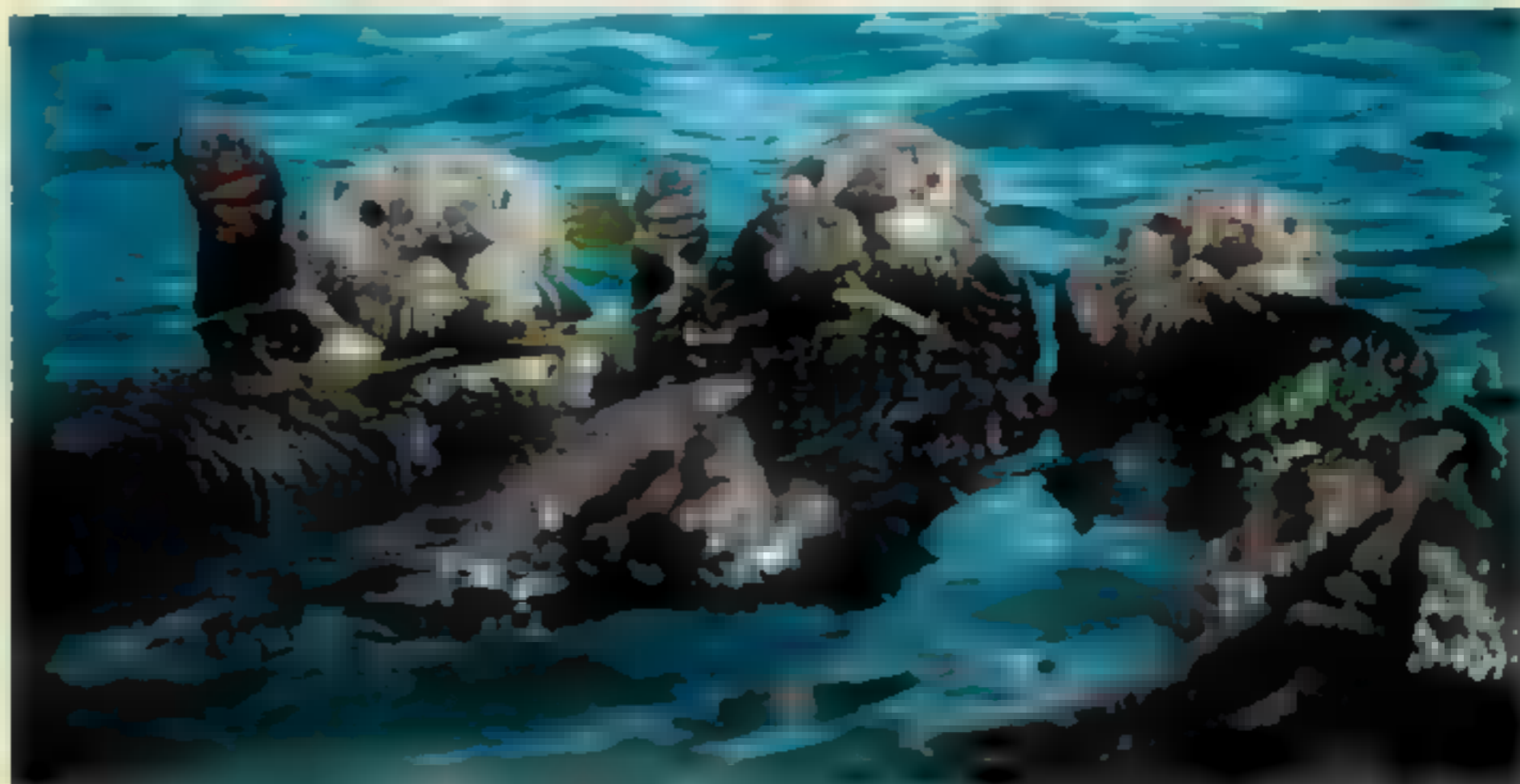
tested positive for toxoplasma antibodies.

Cat waste reaching the ocean in runoff could be the culprit: Miller found that otters living near major stream and river mouths were almost three times more likely to be infected than

otters near low-runoff sites.

The parasite causes fatal encephalitis in otters, suggesting another reason why their California population is less than 2,200, down 10 percent from 1995.

—John L. Eliot



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JOCHEM WILNANDS

## CONSERVATION

## A Boost for Imperial Wings

**F**or one of the rarest birds of prey, the Spanish imperial eagle, chances may be improving.

Five eaglets that hatched last year in Andalusia were collected

and raised at the La Janda research station in Cádiz, Spain. Researchers recently radio tagged and released the birds (above) in hopes of starting and then studying a new population.

The birds became rare in the late 19th century, when hunting thinned their ranks.

"There are more Spanish imperial eagle skins in museums than there are live birds in the field," says Miguel Ferrer of the Doñana Biological Station. Today only about 150 breeding pairs are alive. —John L. Eliot



JAMES L. STANFIELD

## ROME

## Caesar, Say "Cheese"

**I**t's been centuries since gladiators were banned in Rome; now a plan to regulate street performers will give new recognition to some professions with ancient roots. Caesars, Cleopatras, and other characters charge a fee to pose for mostly amused tourists, but some visitors have accused them of harassment and overcharging (up to \$50). Now the city has fixed the price of a photo (about \$5) and performers will have to compete for the 50 or so licenses to be granted. They can have no past convictions for fraud and will be judged on "historical consistency."

—Marco Pinna  
NGM ITALIAN EDITION



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# Behind the SCENES

AT THE NATIONAL GEOGRAPHIC SOCIETY



VICTOR COBO

## A Gathering of the Tribes

*Powwow heralds a new Native American museum*

The Society has chronicled and celebrated Native American culture since the 1890s, so it seemed natural to sign on as a sponsor of the Smithsonian National Museum

of the American Indian's first national powwow. The event took place on the Mall in Washington (above) and drew more than 25,000 people to two days of song and dance by Native

Americans. The event portends a lively future for the museum, which will open its first Washington facility—near the site of the festival—next year. The Society's book division will publish *Native Universe*, a cultural history of American Indians by Native American authors this fall, and, in 2004, a guide to the museum's collections.

## A Hunter Shoots, A Photographer Wins

"This is just a human being going into the forest to get meat to feed his family," says Michael Nichols of his photo of a Congolese man on a legal hunt—as opposed to poaching—from the October 2000 issue. It won "The World in Our Hands" division of the 2002 Wildlife Photographer of the Year contest, a photography showcase sponsored by British Gas Group. Winners are at London's Natural History Museum through May 5.



NATIONAL GEOGRAPHIC PHOTOGRAPHER MICHAEL NICHOLS



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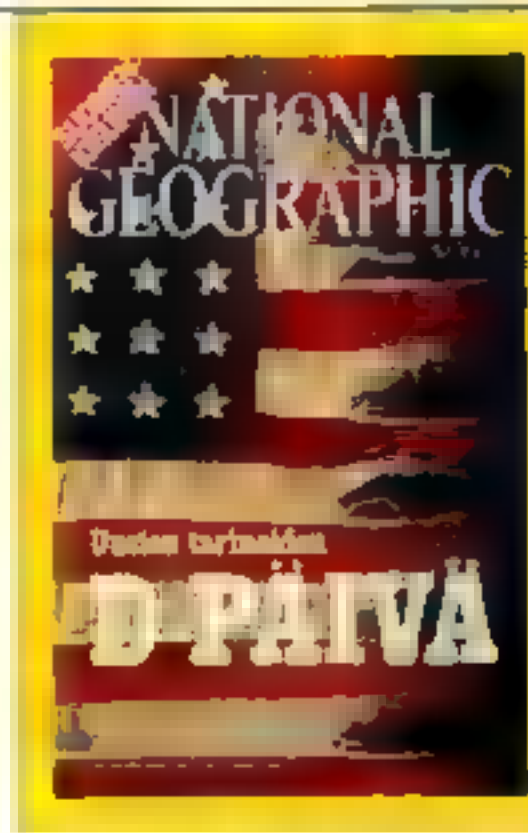
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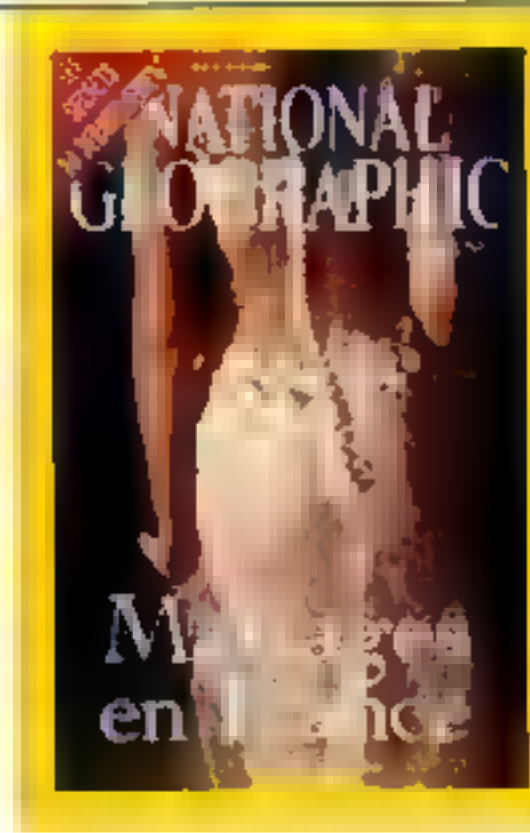
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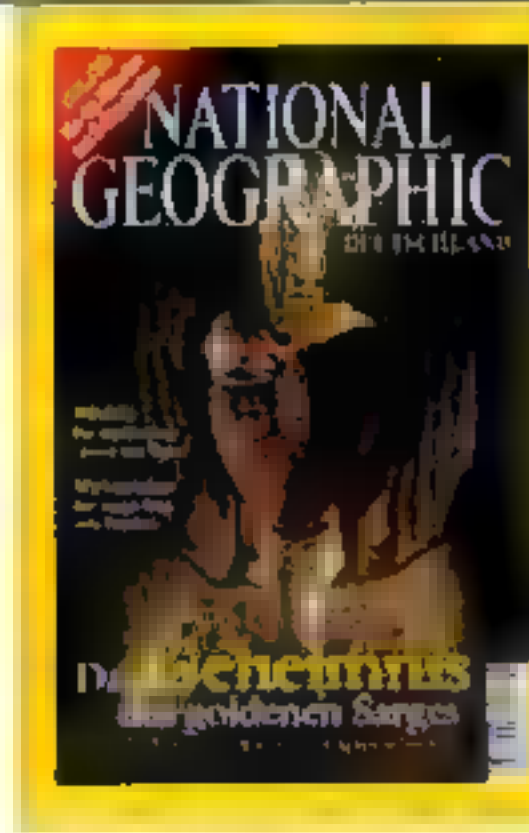
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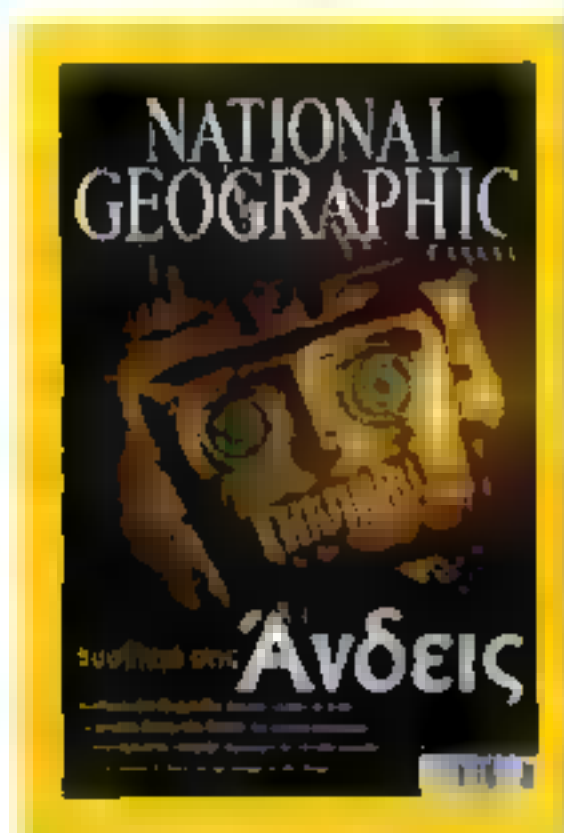
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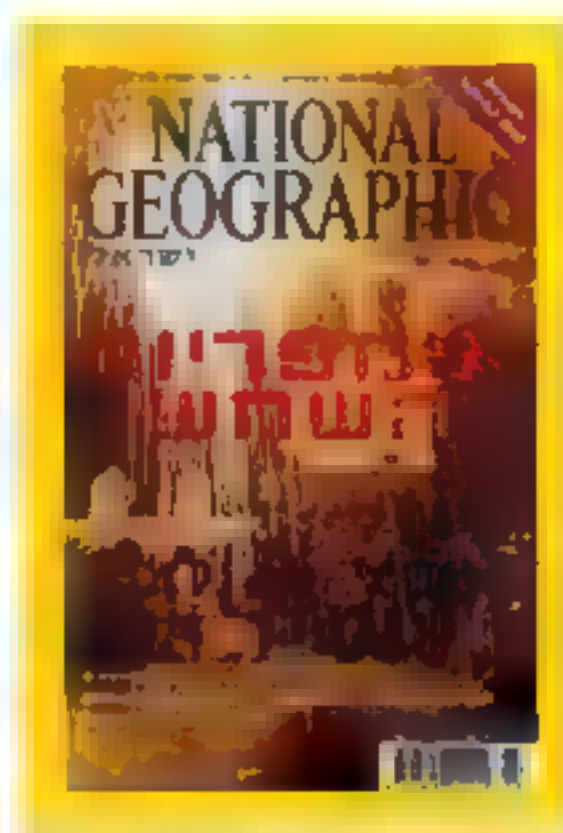
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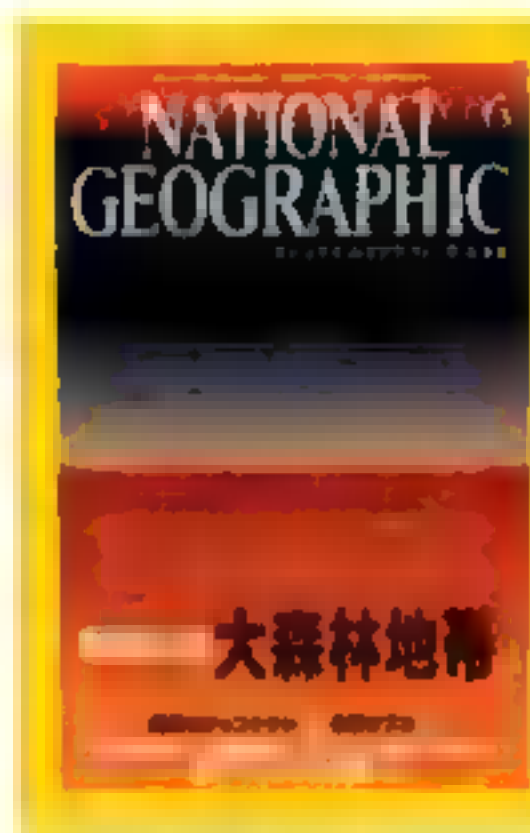
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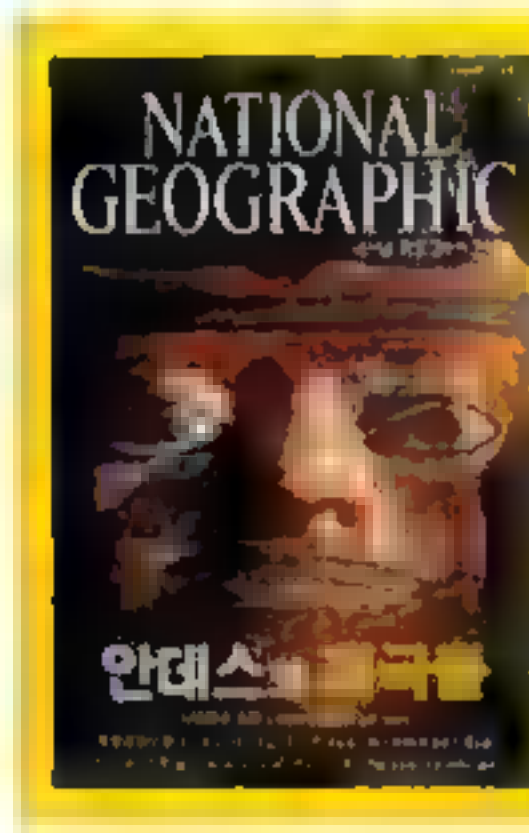
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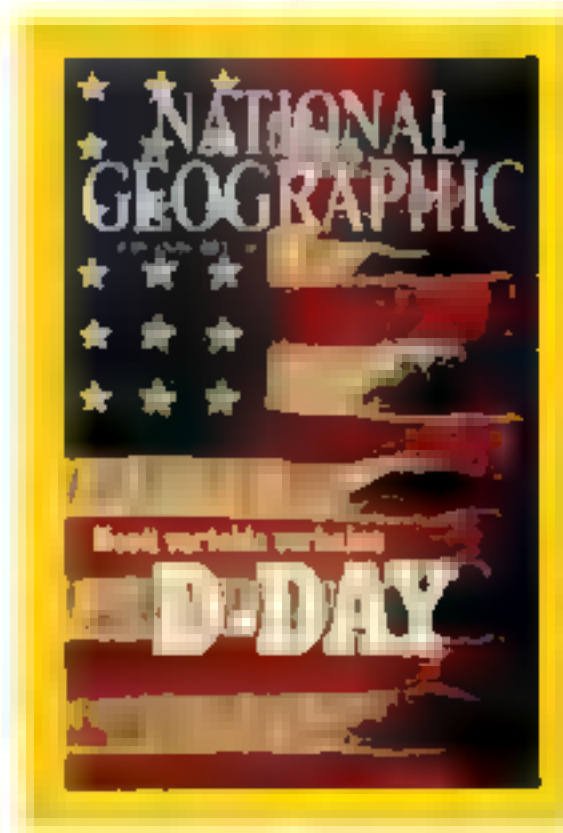
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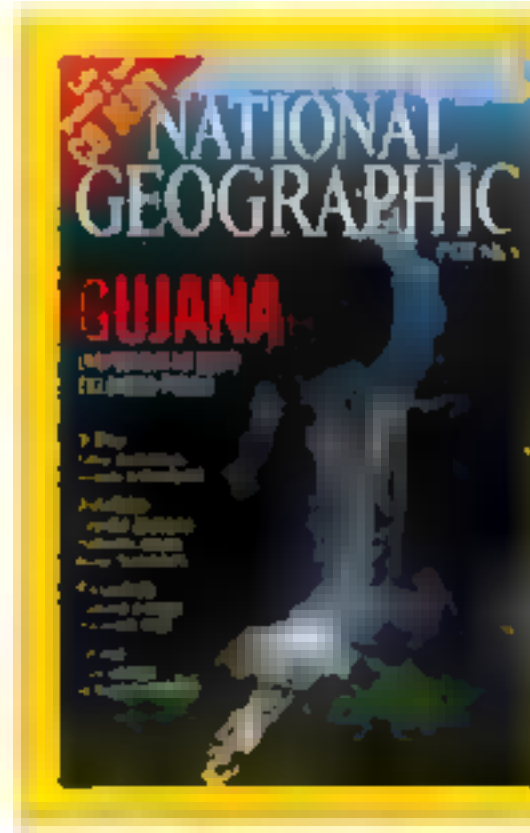
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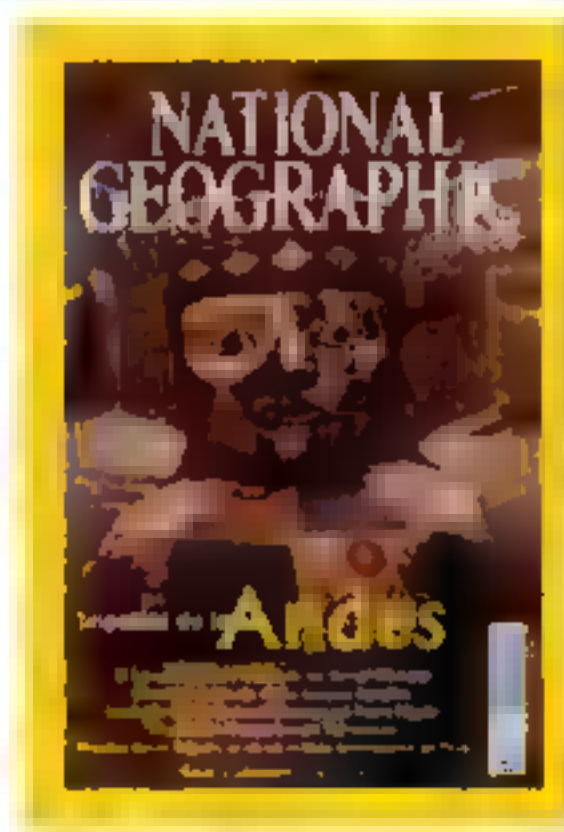
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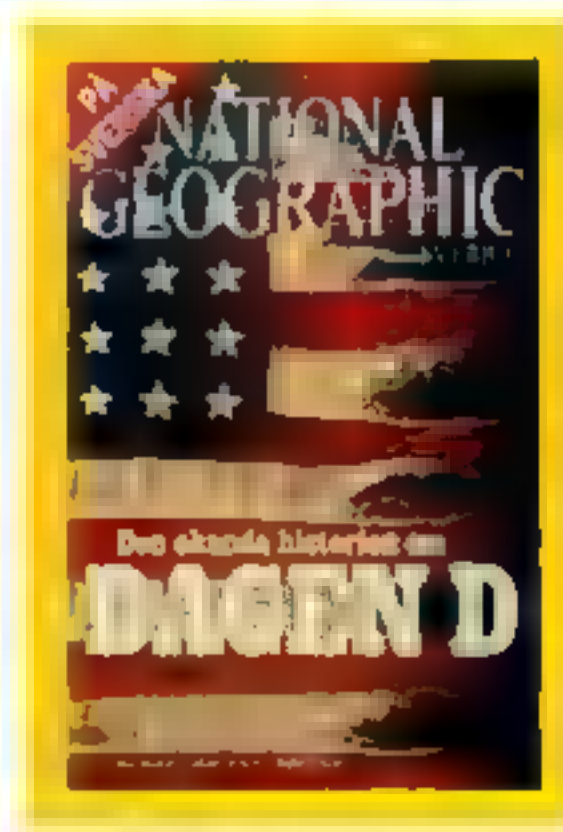
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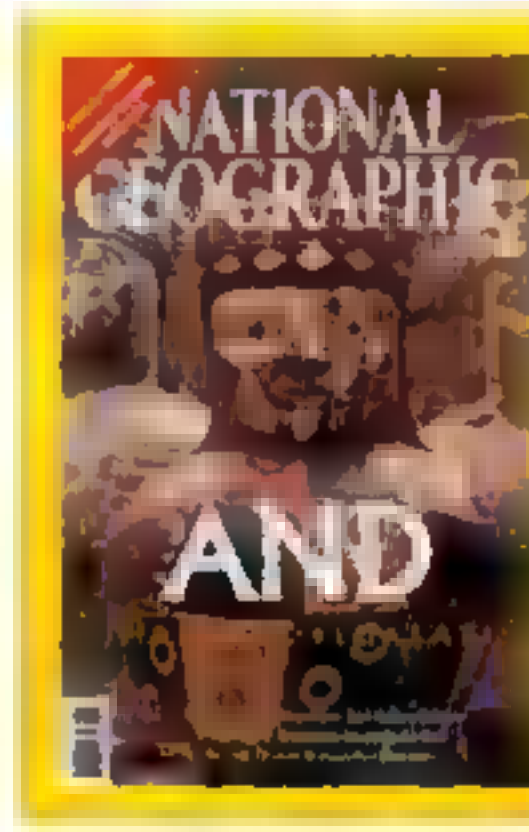
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THAILAND



TURKEY

## A Cover's Changing Face

*When in Rome, or Tokyo, it may look different*

A fine array of images leaped from GEOGRAPHIC covers around the world last June. Our 21 local-language editions (a Czech edition has come out since then, and a Hungarian edition debuts this month) contain most of the

articles in the English-language version, but because local tastes vary—and because a much greater percentage of magazines abroad are sold at the newsstand—their editors often prefer a different cover shot.

So-Young Lee of NGM Korea

thought her readers “too nationalistic” to accept a foreign flag. Japan’s Kunihiro Nagasaka sought “a peaceful and beautiful image for the June cover.” But the Scandinavian editions ran the original U.S. cover photo; so did the Dutch. “The American contribution to the liberation of Europe is still highly respected by our readers,” said Dutch editor Aart Aarsbergen.

You can almost hear it scratching  
at the garage door.



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# Building the Perfect Beast

*The artist behind our dinosaur gets an eyeful*



KURT MUTCHLER, NGS (ABOVE); NGS PHOTOGRAPHER MARK THIESSEN (TOP)

For the past several months, magazine staffers have tiptoed carefully past art director Chris Sloan's office. It looked as though there was a dinosaur in there.

Actually, he was at work on a life-size model of an *Allosaurus* head (above)—whose image

was digitally manipulated for illustrations in this month's article on dinosaur behavior (pages 12-13).

New studies are making it easier to guess at how dinosaurs must have looked, but it's harder to say what they looked through—the soft tissue of their eyes

leaves no trace in the fossil record. For Chris's model, Larry Witmer, an evolutionary biologist at Ohio University in Athens, chose from among several handblown glass models (top): He could have picked eyes like a bird's, eyes like a crocodile's, or eyes that were a bird-crocodile hybrid. The *Allosaurus* wound up with birdlike eyeballs because, as Witmer pointed out, birds are this dinosaur's nearest living relatives.

Even more important than what the eyes looked like is where they were placed. Witmer advised Chris on where to position the eyeball amid clay muscle and eyelids.

The project left Chris's office a mess, with clay everywhere. "But I loved getting a chance to do myself what I usually commission others to do," he says. "And it looks like an *Allosaurus* to me."

## Sing With Us: Da-da-da-DAH-da . . .

It's hard to avoid the music of Elmer Bernstein. Since his first film score for *Saturday's Hero* in 1951, Bernstein (right) has had an astonishingly prolific career, composing for films as diverse as *The Magnificent Seven* in 1960, *Ghostbusters* in 1984, and *Far From Heaven* in 2002. His music also pops up in the fanfare that has signaled the beginning of National Geographic Television programs for more than three decades.

Bernstein says he doesn't remember which Society TV Special he was scoring—we

found out that it was 1966's "Voyage of the Brigantine *Yankee*"—when a producer was struck by a particular musical phrase. "They asked me if it would be OK to make it a permanent theme, and I said



GEORGE STEINMETZ

yes," he says. And so it became.

Bernstein, now 80, has earned 13 Academy Award nominations and continues to garner critical acclaim. He won the Oscar for best original score in 1967 for *Thoroughly Modern Millie*.

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**BRIEF SUMMARY** Before prescribing NEXIUM, please see full Prescribing Information.  
**INDICATIONS AND USAGE** NEXIUM is indicated for the short-term treatment (4 to 8 weeks) in the healing and symptomatic resolution of diagnostically confirmed erosive esophagitis. **CONTRAINDICATIONS** NEXIUM is contraindicated in patients with known hypersensitivity to any component of the formulation or to substituted benzimidazoles. **PRECAUTIONS** Symptomatic response to therapy with NEXIUM does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole, of which NEXIUM is an enantiomer. **Information for Patients:** NEXIUM Delayed-Release Capsules should be taken at least one hour before meals. For patients who have difficulty swallowing capsules, one tablespoon of applesauce can be added to an empty bowl and the NEXIUM Delayed-Release Capsule opened, and the pellets carefully emptied onto the applesauce. The pellets should be mixed with the applesauce and then swallowed immediately. The applesauce used should not be hot and should be soft enough to be swallowed without chewing. The pellets should not be chewed or crushed. The pellet/applesauce mixture should not be stored for future use. Antacids may be used while taking NEXIUM. **Drug Interactions:** Esomeprazole is extensively metabolized in the liver by CYP2C19 and CYP3A4. *In vitro* and *in vivo* studies have shown that esomeprazole is not likely to inhibit CYPs 1A2, 2A6, 2C9, 2D6, 2E1 and 3A4. No clinically relevant interactions with drugs metabolized by these CYP enzymes would be expected. Drug interaction studies have shown that esomeprazole does not have any clinically significant interactions with phenytoin, warfarin, quinidine, clarithromycin or amoxicillin. Esomeprazole may potentially interfere with CYP2C19, the major esomeprazole metabolizing enzyme. Coadministration of esomeprazole 30 mg and diazepam, a CYP2C19 substrate, resulted in a 45% decrease in clearance of diazepam. Increased plasma levels of diazepam were observed 12 hours after dosing and onwards. However, at that time, the plasma levels of diazepam were below the therapeutic interval, and thus this interaction is unlikely to be of clinical relevance. Esomeprazole inhibits gastric acid secretion. Therefore, esomeprazole may interfere with the absorption of drugs where gastric pH is an important determinant of bioavailability (eg, ketoconazole, iron salts and digoxin). Coadministration of oral contraceptives, diazepam, phenytoin, or quinidine did not seem to change the pharmacokinetic profile of esomeprazole. **Carcinogenesis, Mutagenesis, Impairment of Fertility:** The carcinogenic potential of esomeprazole was assessed using omeprazole studies. In two 24-month oral carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (about 0.7 to 57 times the human dose of 20 mg/day expressed on a body surface area basis) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg omeprazole/kg/day (about 5.6 times the human dose on a body surface area basis) for 1 year, then followed for an additional year without the drug. Carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. Gastric adenocarcinoma was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat, a similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Esomeprazole was negative in the Ames mutation test, the *in vivo* rat bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. Esomeprazole, however, was positive in the *in vitro* human lymphocyte chromosome aberration test. Omeprazole was positive in the *in vitro* human lymphocyte chromosome aberration test, the *in vivo* mouse bone marrow cell chromosome aberration test, and the *in vivo* mouse micronucleus test. The potential effects of esomeprazole on fertility and reproductive performance were assessed using omeprazole studies. Omeprazole at oral doses up to 138 mg/kg/day in rats (about 56 times the human dose on a body surface area basis) was found to have no effect on reproductive performance of parental animals. **Pregnancy: Teratogenic Effects. Pregnancy Category B—**Teratology studies have been performed in rats at oral doses up to 280 mg/kg/day (about 57 times the human dose on a body surface area basis) and in rabbits at oral doses up to 86 mg/kg/day (about 35 times the human dose on a body surface area basis) and have revealed no evidence of impaired fertility or harm to the fetus due to esomeprazole. There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, this drug should be used during pregnancy only if clearly needed. Teratology studies conducted with omeprazole in rats at oral doses up to 138 mg/kg/day (about 56 times the human dose on a body surface area basis) and in rabbits at doses up to 86 mg/kg/day (about 35 times the human dose on a body surface area basis) did not disclose any evidence for a teratogenic potential of omeprazole. In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (about 5.5 to 56 times the human dose on a body surface area basis) produced dose-related increases in embryolethality, fetal resorptions, and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole at 13.8 to 138.0 mg/kg/day (about 5.6 to 56 times the human doses on a body surface area basis). There are no adequate and well-controlled

studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. **Nursing Mothers:** The excretion of esomeprazole in milk has not been studied. However, omeprazole concentrations have been measured in breast milk of a woman following oral administration of 20 mg. Because esomeprazole is likely to be excreted in human milk, because of the potential for serious adverse reactions in nursing infants from esomeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. **Pediatric Use:** Safety and effectiveness in pediatric patients have not been established. **Geriatric Use:** The total number of patients who received NEXIUM in clinical trials, 778 were 65 to 74 years of age and 124 patients were  $\geq$  75 years of age. No overall differences in safety and efficacy were observed between the elderly and younger individuals, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out. **ADVERSE REACTIONS** The safety of NEXIUM was evaluated in over 10,000 patients (aged 18-84 years) in clinical trials worldwide including over 7,400 patients in the United States and over 2,600 patients in Europe and Canada. Over 2,900 patients were treated in long-term studies for up to 6-12 months. In general, NEXIUM was well tolerated in both short- and long-term clinical trials. The safety in the treatment of healing of erosive esophagitis was assessed in four randomized comparative clinical trials, which included 1,240 patients on NEXIUM 20 mg, 2,434 patients on NEXIUM 40 mg, and 3,008 patients on omeprazole 20 mg daily. The most frequently occurring adverse events ( $\geq$ 1%) in all three groups was headache (5.5, 5.0, and 3.8, respectively) and diarrhea (no difference among the three groups). Nausea, flatulence, abdominal pain, constipation, and dry mouth occurred at similar rates among patients taking NEXIUM or omeprazole. Additional adverse events that were reported as possibly or probably related to NEXIUM with an incidence  $<$  1% are listed below by body system: **Body as a Whole:** abdomen enlarged, allergic reaction, asthenia, back pain, chest pain, chest pain substernal, facial edema, peripheral edema, hot flushes, fatigue, fever, flu-like disorder, generalized edema, leg edema, malaise, pain, rigors; **Cardiovascular:** flushing, hypertension, tachycardia; **Endocrine:** goiter; **Gastrointestinal:** bowel irregularity, constipation aggravated, dyspepsia, dysphagia, dysplasia GI, epigastric pain, eructation, esophageal disorder, frequent stools, gastroenteritis, GI hemorrhage, GI symptoms not otherwise specified, hiccup, melena, mouth disorder, pharynx disorder, rectal disorder, serum gastrin increased, tongue disorder, tongue edema, ulcerative stomatitis, vomiting; **Hearing:** earache, tinnitus; **Hematologic:** anemia, anemia hypochromic, cervical lymphadenopathy, epistaxis, leukocytosis, leukopenia, thrombocytopenia; **Hepatic:** bilirubinemia, hepatic function abnormal, SGOT increased, SGPT increased; **Metabolic/Nutritional:** glycosuria, hyperuricemia, hyponatremia, increased alkaline phosphatase, thirst, vitamin B12 deficiency, weight increase, weight decrease; **Musculoskeletal:** arthralgia, arthritis aggravated, arthropathy, cramps, fibromyalgia syndrome, hernia, polymyalgia rheumatica; **Nervous System/Psychiatric:** anorexia, apathy, appetite increased, confusion, depression aggravated, dizziness, hypertonia, nervousness, hypoesthesia, impotence, insomnia, migraine, migraine aggravated, paresthesia, sleep disorder, somnolence, tremor, vertigo, visual field defect; **Reproductive:** dysmenorrhea, menstrual disorder, vaginitis; **Respiratory:** asthma aggravated, coughing, dyspnea, larynx edema, pharyngitis, rhinitis, sinusitis; **Skin and Appendages:** acne, angioedema, dermatitis, pruritus, pruritus ani, rash, rash erythematous, rash maculo-papular, skin inflammation, sweating increased, urticaria; **Special Senses:** otitis media, parosmia, taste loss, taste perversion; **Urogenital:** abnormal urine, albuminuria, cystitis, dysuria, fungal infection, hematuria, micturition frequency, moniliasis, genital moniliasis, polyuria; **Visual:** conjunctivitis, vision abnormal. Endoscopic findings that were reported as adverse events include: duodenitis, esophagitis, esophageal stricture, esophageal ulceration, esophageal varices, gastric ulcer, gastritis, hernia, benign polyps or nodules, Barrett's esophagus, and mucosal discoloration. **Postmarketing Reports** - There have been spontaneous reports of adverse events with post-marketing use of esomeprazole. These reports have included rare cases of anaphylactic reaction. Other adverse events not observed with NEXIUM, but occurring with omeprazole can be found in the omeprazole package insert. **ADVERSE REACTIONS** section. **OVER-DOSAGE** A single oral dose of esomeprazole at 510 mg/kg (about 103 times the human dose on a body surface area basis), was lethal to rats. The major signs of acute toxicity were reduced motor activity, changes in respiratory frequency, tremor, ataxia, and intermittent clonic convulsions. There have been reports of overdose with esomeprazole. Reports have been received of overdosage with omeprazole in humans. Doses ranged up to 2,400 mg (120 times the usual recommended clinical dose). Manifestations were variable, and included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, dry mouth, and other adverse reactions similar to those seen in normal clinical experience (see omeprazole package insert-ADVERSE REACTIONS). No specific antidote for esomeprazole is known. Since esomeprazole is extensively protein bound, it is not expected to be removed by dialysis. In the event of overdosage, treatment should be symptomatic and supportive. As with the management of any overdose, the possibility of multiple drug ingestion should be considered. For current information on treatment of any drug overdose, a certified Regional Poison Control Center should be contacted. Telephone numbers are listed in the Physicians' Desk Reference (PDR) or local telephone book.

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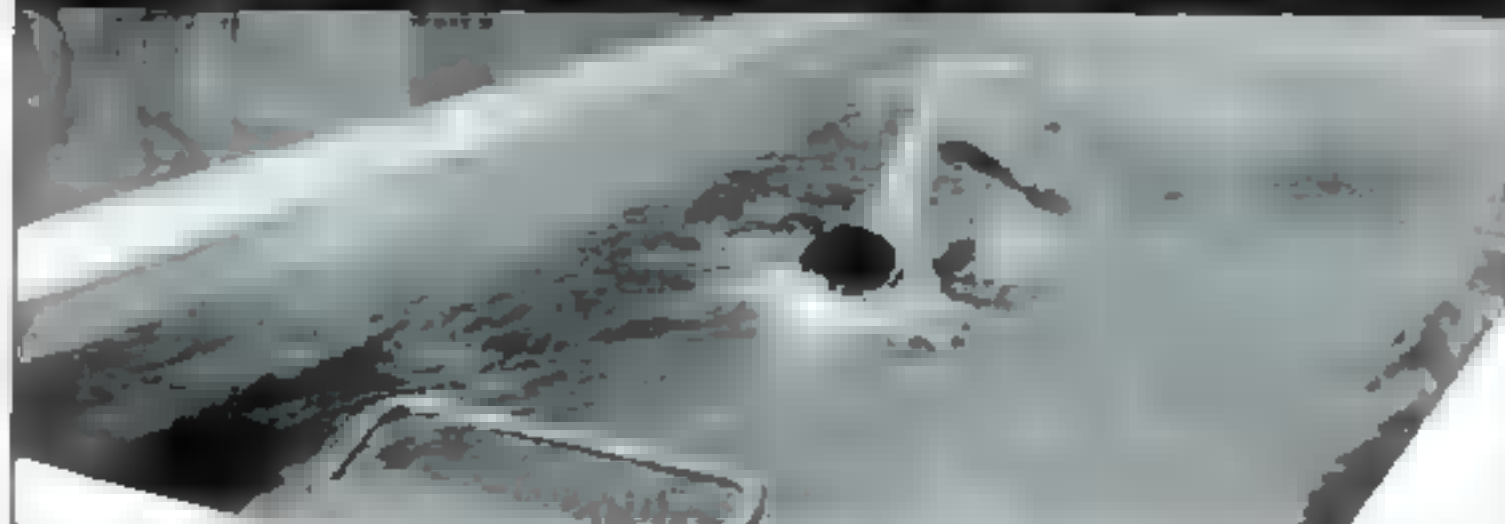
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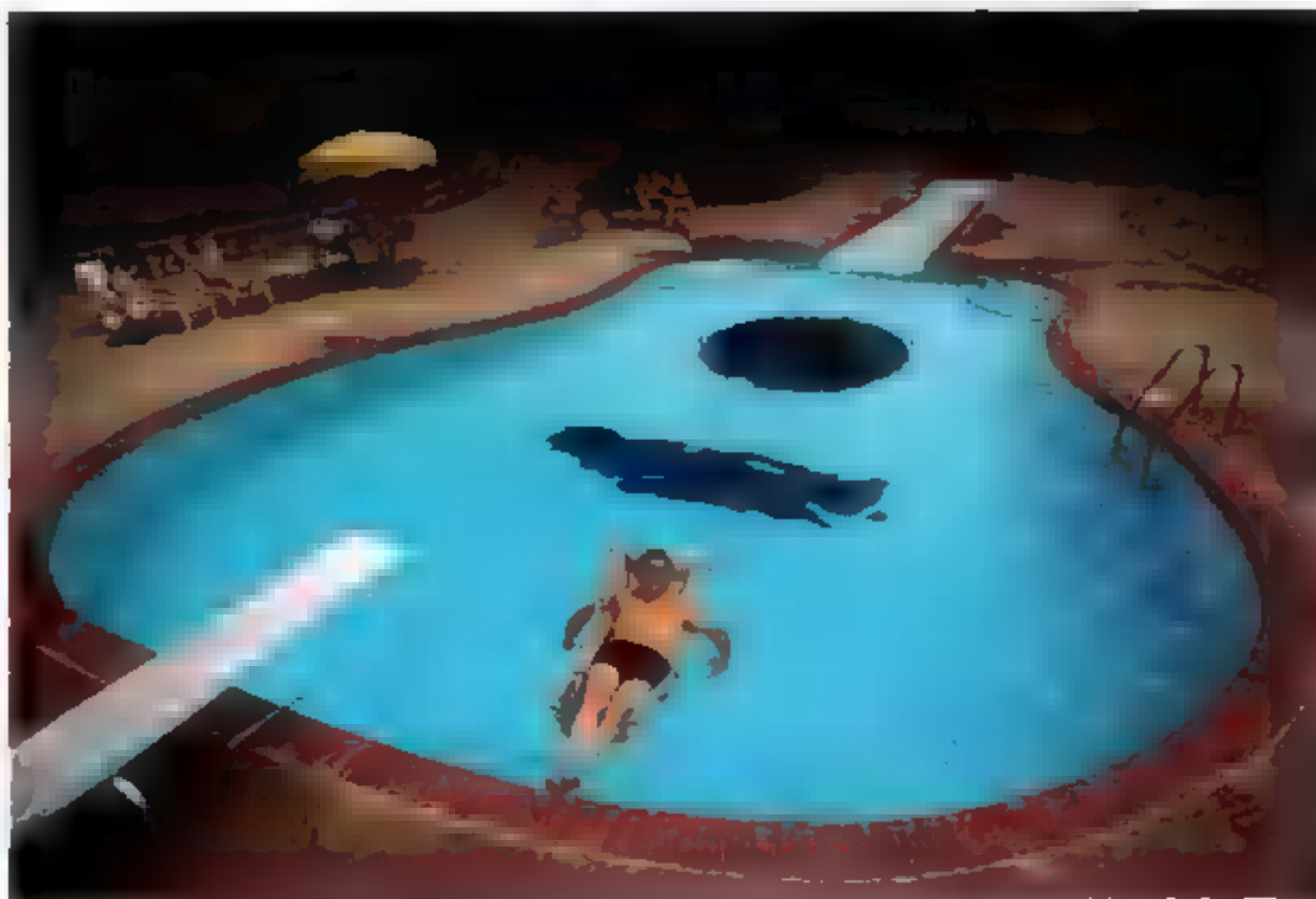
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JOHN KARR, THE ASIA FOUNDATION (ABOVE); NGS PHOTOGRAPHER JODI COBB

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BEVERLY JOUBERT (ABOVE); NGS PHOTOGRAPHER MICHAEL NICHOLS

Legendary filmmakers Dereck and Beverly Joubert set up camp at a shrinking water hole in Botswana, where lions hunt the biggest game on Earth—elephants. Usually wary of the large creatures, lions here team up to attack elephant calves and even adults during the dry season.



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# Who Knew?

## LONGEVITY

### The Skinny on Aging

*Old cells, free radicals, and no breakfast*

It used to be that food merely made us fat. Now science tells us that food can't be converted into energy without creating rogue molecules, which bash into once youthful cells and make them old and haggard.

Through a microscope, old cells actually can look old. "They get kind of big and raggedy," says Huber Warner, an associate director at the National Institute on Aging (NIA). "Young cells look like little torpedoes and pack together nicely."

Cells begin to age quickly once they stop dividing. A human skin cell divides about 50 times in a lifetime—maybe 60 or 70. This cycle is regulated, in part, by telomeres. These are sequences of DNA that mark the ends of chromosomes, a bit like the plastic caps on the tips of shoelaces. Each cell division slowly whittles away a tiny bit of the telomeres. When they get too short, cell division ceases.

Telomeres protect us from cancer, explains cell biologist Judith Campisi, because tumors can develop if cells divide forever. But when they stop dividing, our bodies soon become hosts to millions of decrepit cells.

So how do the old cells get so beat up? One way is from free radicals—molecules that break through cell



membranes and damage proteins and DNA. Free radicals are a normal by-product of metabolism and our bodies have built-in defenses against them: enzymes that convert them to water, for instance. Antioxidants like vitamin E, vitamin C, selenium, and beta carotene may help the counterattack.

But might it be possible to produce fewer free radicals to begin with? Sure. Cut back on food. Way, way back. This unorthodox practice is proposed by Mark Mattson, a neurobiologist at NIA. He says that in mice, restricting calories adds at least a year to their average three-year life spans. Their ability to regulate blood sugar levels improves, and their cells become better able to respond to stress.

It's unclear whether humans can benefit from an ultra-low-cal diet, but the NIA is supporting three exploratory studies over the next few years. In the meantime, Mattson has been using himself as a test subject. He's been eating a third fewer calories than the average person for more than a decade. At five feet nine inches tall, he weighs a scant 120 pounds. In lieu of breakfast, he exercises. He doesn't touch ice cream. His one indulgence: For a bedtime snack he'll have a bowl of oatmeal. With raisins.

Can he convince others to adopt the same unappealing diet? It might take a while, he admits. And since he's only 45, it's impossible to know if his antiaging scheme even works. We'll check back in 50 years.

—Joel Achenbach

WASHINGTON POST STAFF WRITER

## IT MATTERS

### More isn't always better.

Taken in excess, even good-for-you stuff—like vitamin C, vitamin E, and the antioxidant mineral selenium—can make you sick. More than 2,000 milligrams of vitamin C can cause diarrhea; more than 1,000 milligrams of vitamin E can interfere with blood clotting. Selenium doses exceeding 400 micrograms can make hair fall out and nails slough off. It matters that we learn the risks, as well as the benefits, of supplements. Americans spend billions of dollars on vitamins and minerals each year, and use them mostly without talking to a doctor or dietician. In response, the National Academy of Sciences has established "tolerable upper limits" for many nutrients to accompany their familiar recommended dietary allowances.

—Lynne Warren

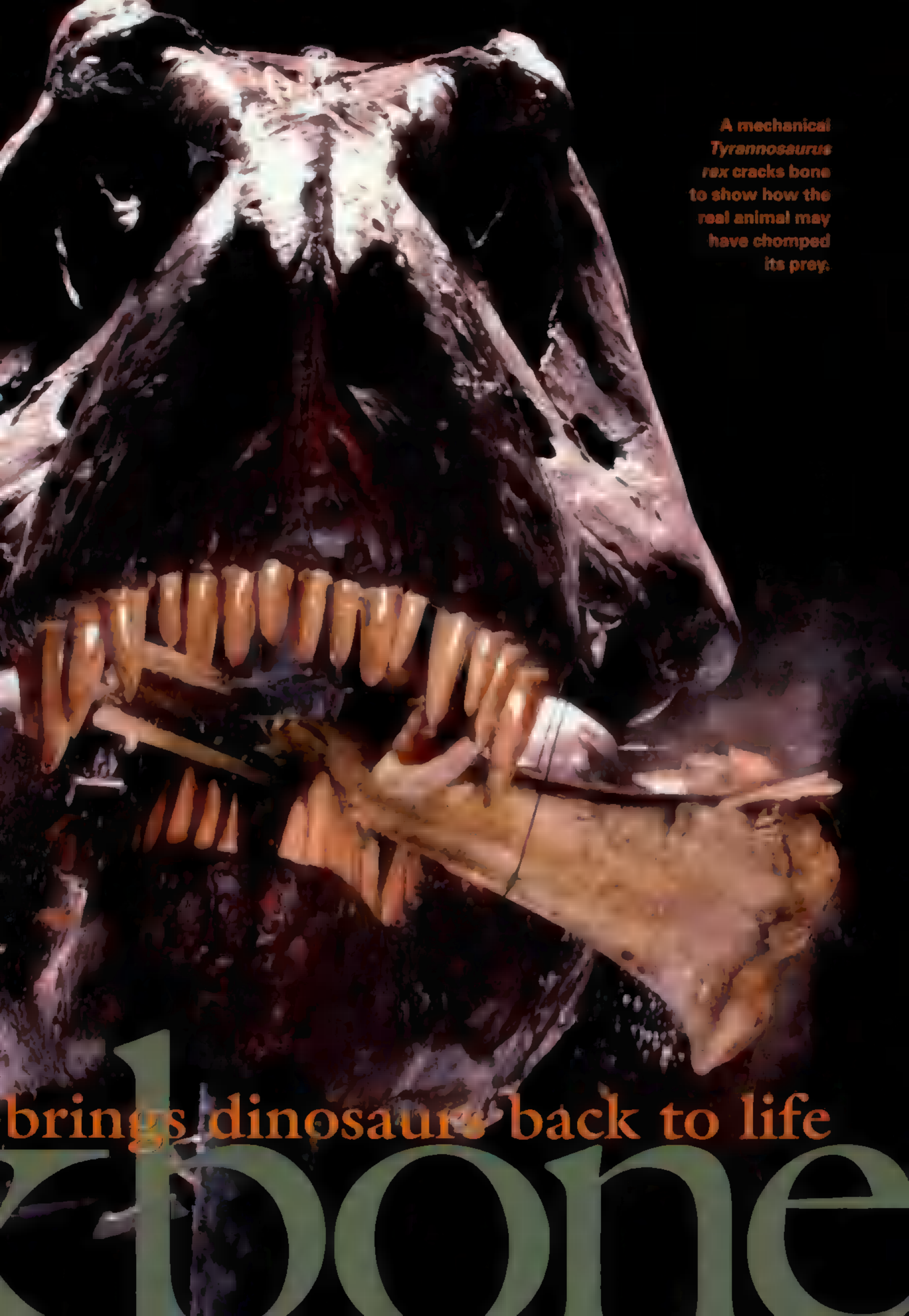
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Learn more about cellular aging—and find links to Joel Achenbach's work—at [nationalgeographic.com/ngm/resources/0303](http://nationalgeographic.com/ngm/resources/0303).



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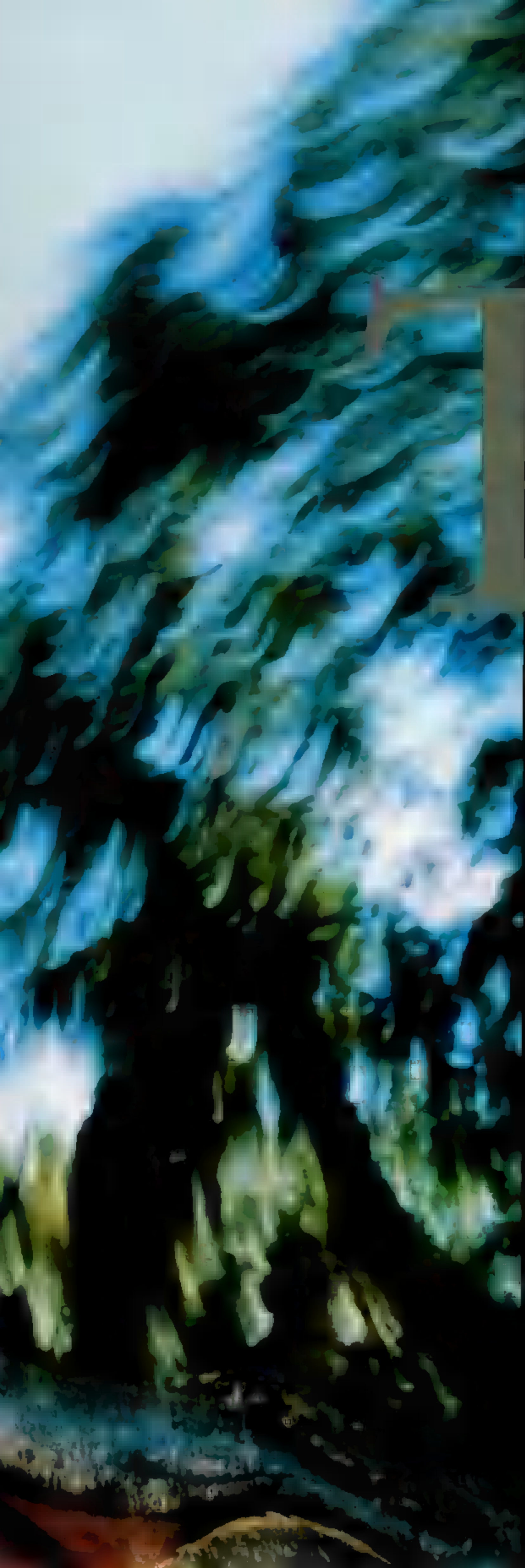


A mechanical  
*Tyrannosaurus*  
*rex* cracks bone  
to show how the  
real animal may  
have chomped  
its prey.

brings dinosaurs back to life

# Robone





By Joel Achenbach  
Photographs by Robert Clark  
Art by John Sibbick

The bull gator lay in the sand under the oak trees. A few days earlier he had been hauled out of a murky lake in central Florida. Researchers instantly named him Mr. Big. He was sofa-size, with fat jowls framing his head like a couple of throw pillows. He would have measured thirteen and a half feet if a rival hadn't chomped the last foot off his tail.

Four people sat on his back. Excited alligators do more than thrash—they can spin like wound-up rubber bands. Yet Mr. Big, with his mouth taped shut and a towel over his eyes, was completely docile, as inert as luggage. He behaved like a gator basking in the sun rather than one in the middle of a science experiment.

Gregory Erickson, the scientist, stood a few paces away, grimly holding a plastic pole tipped with a little square plate called a force transducer. He intended

## Brute Strength

**Face-off:** Gregory Erickson prepares to test the force of an alligator bite with a padded calibrator on a pole. "You set the device on its teeth, and it bites," says the Florida State University paleobiologist. "It thinks it has you." Large adult gators, he has found, can snap their jaws shut with as much as 3,000 pounds of force—the strongest bite known among living creatures. With similarities in teeth and jaws, *T. rex* probably gnashed at its prey just as viciously.



to put this in the animal's mouth, to measure the force of its bite. Erickson also intended to retain all his body parts, which explained his serious countenance.

A man on the gator's back removed the towel and the tape. The animal opened its eyes and hissed. It was a factory noise, a steam pipe venting. The mouth opened as slowly as a drawbridge. The maw on Mr. Big was spacious enough to house a poodle. Erickson presented the force transducer to the largest tooth at the back of the right upper jaw—and the jaws snapped shut.

"Trouble, we got trouble!" Erickson said as the gator, pole firmly clamped, began to lurch

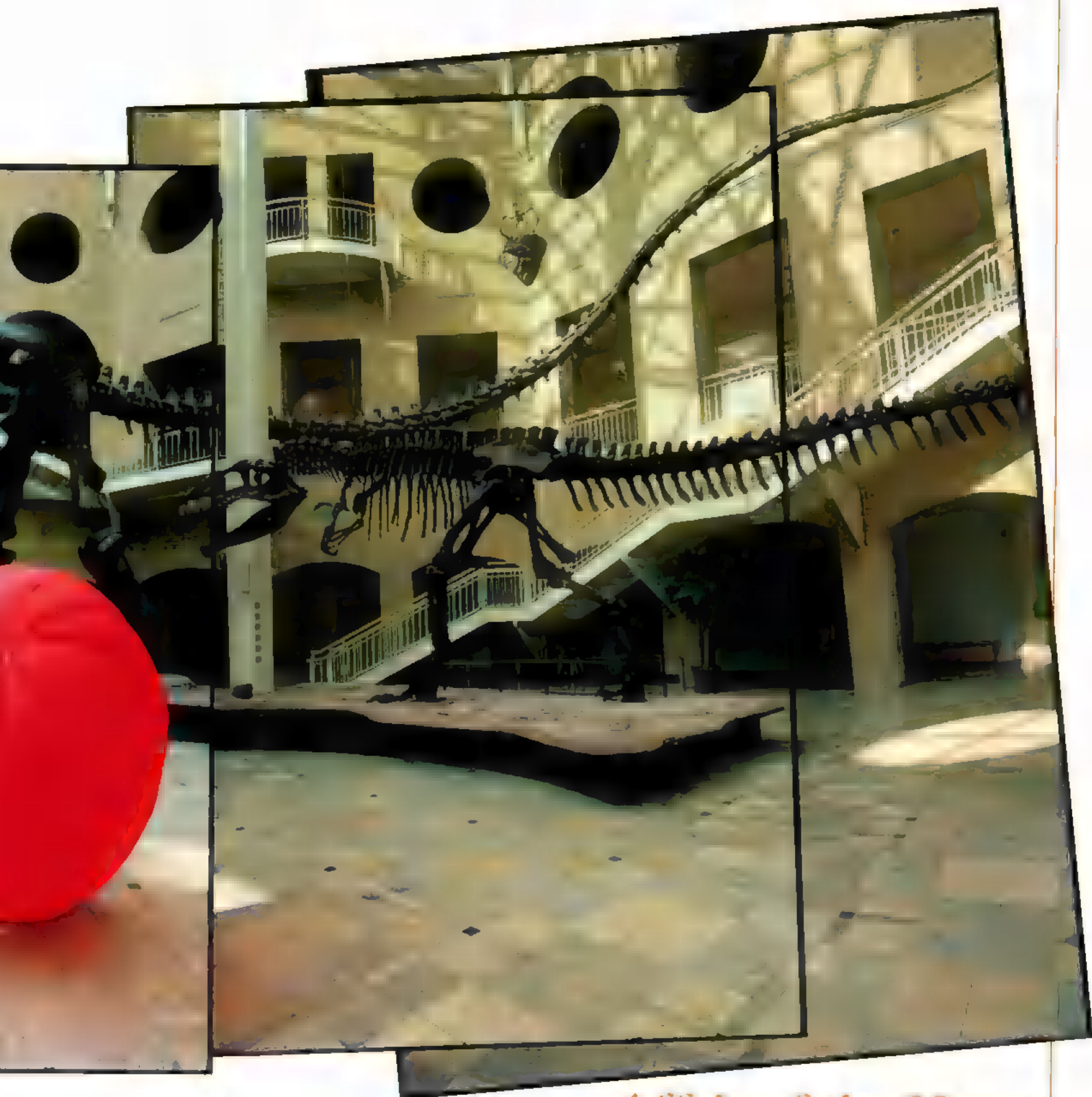
in his direction. But then the animal calmed down. Erickson read some numbers off a meter. "Two point nine six—that's a lot!" he said.

The creature's jaws had come together with nearly 3,000 pounds of force.

The odd thing about this little experiment was that it was fundamentally about dinosaurs. Erickson, a paleobiologist at Florida State University, is an expert in the feeding behavior of tyrannosaurs, including the bite marks left on bones. That research spurred him to find out more about bites in general, which is why he's out here moonlighting with crocodilians.

We loaded Mr. Big on an airboat to be towed overland back home to Lake Griffin, about an





## Affair of the Heart

hour to the south. We spent the night lakeside, testing ten more gators that had been freshly yanked from the water. All the while, we talked about dinosaurs.

Shortly before dawn—by which time we were thoroughly scuffed up and swampy, though still in possession of all our digits—Erickson turned to me and said, “It’s not like diggin’ bones, is it?”

Bone-diggin’ is still essential, but an increasing number of vertebrate paleontologists are going beyond the bones, looking for novel ways to study dinosaurs.

Instead of spending the summer in a dusty badlands bone bed, they might spend it in a laboratory, analyzing the evolution of the flight

From end to end a 90-million-year-old *Argentinosaurus* skeleton stretches 127 feet across Atlanta’s Fernbank Museum. Was this—perhaps the largest land animal ever—warm-blooded? That’s doubtful if it could fully raise its head, says Miami University zoologist Dennis Claussen. To pump blood that high, the heart would have to have been at least the size of the red balloon, with seven tons of muscle forming walls almost two feet thick—“an extremely inefficient organ,” says Claussen. “I think these large herbivores lived in the slow lane and were pretty much cold blooded.” In that case the heart of *Argentinosaurus* would have been closer to the size of the blue ball.



stroke by tossing pigeons into a wind tunnel. Instead of scraping away the sandstone overburden on a nicely articulated ceratopsian, they might point and click on a computer screen, pivoting digital bones.

These paleontologists tend to be on the young and idealistic side, determined to intensify the scientific rigor of their profession. Their goal is to hunt not just for dinosaurs but for something even harder to reconstruct—how dinosaurs functioned and behaved.

They are tackling difficult questions:

Were dinosaurs fleet of foot or ponderous?

What did they eat?

Did they hunt or migrate in packs?

Did they parent their young?

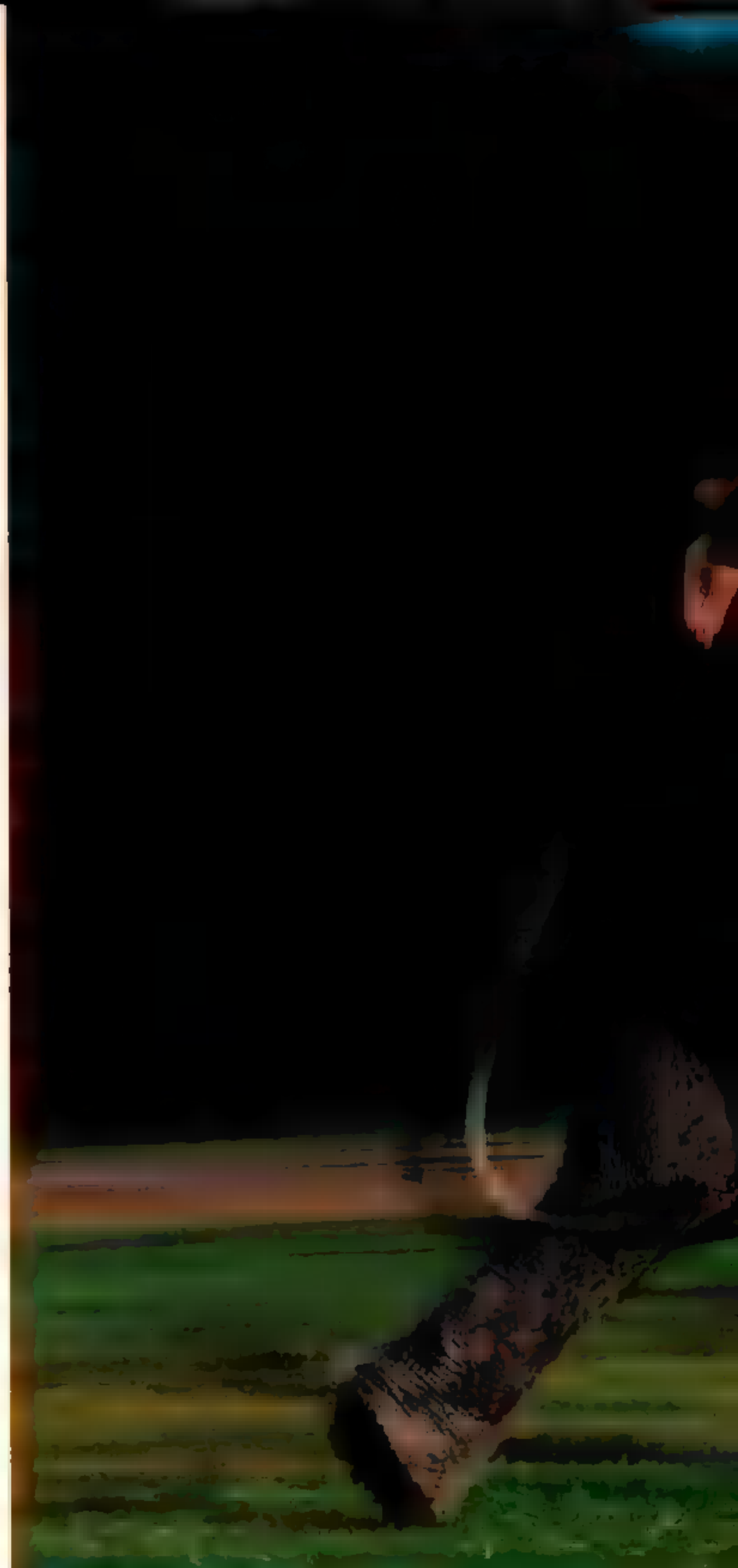
How fast did they grow? Did they get bigger and bigger even into old age? And how old did they get?

Did they use horns and frills and spikes in battle, like they do in the movies? Were these unusual anatomical structures part of the business of attracting mates?

How did one group of these creatures develop the ability to fly?

These new scientists are a diverse bunch, emerging from evolutionary biology, biomechanics, botany, physiology. Their tools include computers, CT scans, x-rays, and electron microscopes. They publish papers with titles like “Nostril Position in Dinosaurs and Other Vertebrates and Its Significance for Nasal Function” and “Caudofemoral Musculature and the Evolution of Theropod Locomotion.” We might say they are geekier than the older generation of dinosaur researchers, and then quickly add that we mean this in the best sense of the word.

Make no mistake, the “field”—which is anywhere and everywhere bones can be found—still dominates dinosaur research. In recent years the field has produced feathered dinosaurs from China, egg-laying dinosaurs from Patagonia, and a host of new dinosaur species, such as the scale-breaking *Argentinosaurus* and the fearsome *Giganotosaurus*. In the field we find direct evidence of a lost world. (Continued on page 14)



## Living Large

Was *T. rex* a speed demon? Probably not, suggests a study of elephants. Picking up the pace for a video taped in Thailand (above and top) 8,000-pound elephants get up to only about 15 miles an hour. White dots



mark their joints, allowing Stanford University biologist John Hutchinson and colleagues to analyze their motion with a computer.

"Elephants are upholding the theory that a very large body size limits speed," he says.

Calculations based on a *T. rex* model (top, inset) offer more support. For *T. rex* to run

at 45 miles an hour, as some scientists think it did, as much as 90 percent of its body would have to have been leg muscle "That's ridiculous," says Hutchinson. *T. rex* probably didn't move much faster than an elephant.

"Of course, a 13,000-pound animal moving at that speed still would be a horrendous sight."





## Head Doctor

To my friends, I'm an anatomist. To my son, I'm a paleontologist. To my wife, Lawrence is a playfully misbegotten menagerie of his Ohio University lab. Dissection and CT scanning the heads of extant animals gives him insight into features that once fleshed out creatures such as *Majungatholus* and *Camarasaurus*. The skulls appear at left. "To really understand the bones, we have to think about the soft tissues that contributed to the functioning organism," he says.

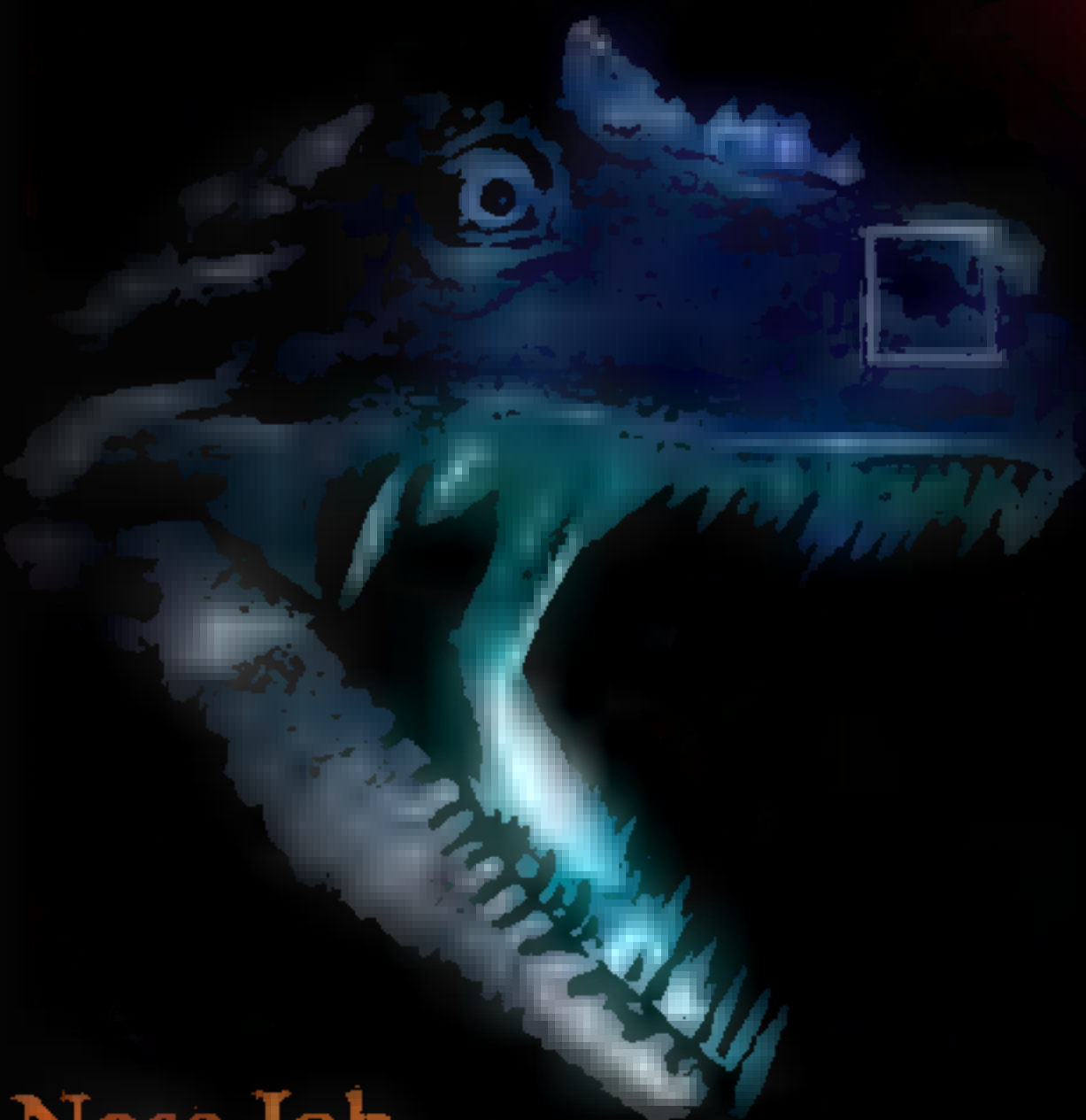
# Rebuilt Godzilla

Born to kill, *Allosaurus* now seems more menacing than ever. New research has modified its snout and has revised ideas about how this 150-million-year-old predator may have used its skull and teeth as lethal weapons.



## Hatchet Head

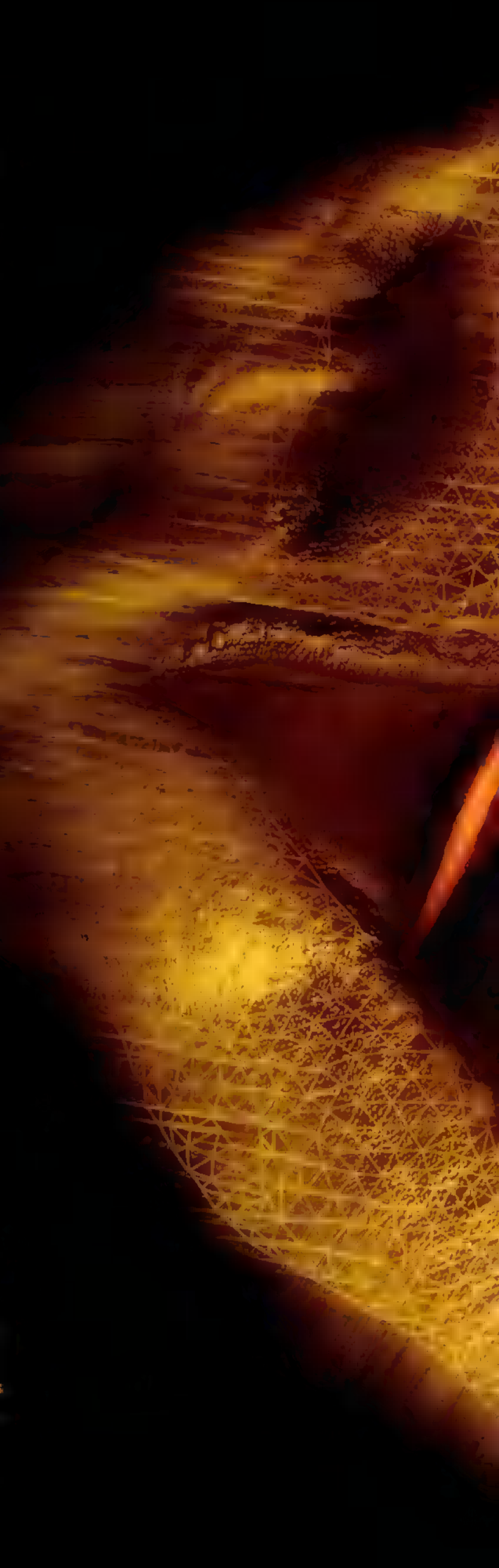
With an engineer's tools, University of Cambridge paleontologist Emily Rayfield built a digital skull (above and enhanced at right) to study the stresses generated by biting. In the image above, red lines show tension, yellow show compression. Her analysis revealed a paradox: weak bite, strong skull. That may mean *Allosaurus* slammed its head downward to slice its teeth into a victim's flesh.



## Nose Job

With only bare bones to guide them, paleontologists once placed the fleshy nostril high on the snout (above). But Larry Witmer has moved it forward (right), more like a lizard. In every modern vertebrate he has studied, the nostril lies low in the bony opening that leads to the nasal cavity. He believes the same was true for dinosaurs.

ART BY CHRISTOPHER SLOAN, NEMO ART, BASED ON FINITE ELEMENT ANALYSIS. IMAGE BY EMILY RAYFIELD, UNIVERSITY OF CAMBRIDGE. PHOTOGRAPHED BY NEMO. PHOTOGRAPHER MARK THERRSEN. FOSSIL SKULL SOURCE: PALEOWORLD.COM





When McCrea presented his master's thesis, he jokingly  
You know, two dinosaurs mating.  
Reptilian passion captured in stone.  
The professors were not visibly amused.

(Continued from page 8) ruled by titanic creatures, thriving all over the globe from 230 to 65 million years ago, during the Mesozoic era.

And the field has charms that the laboratory can't match. The field is the staging ground for that whole Indiana Jones thing, for the type of charismatic, rock-star scientists who hang out in dinosaur graveyards with shovels, picks, plaster, graduate students, and personal documentary film crews.

example, that *Tyrannosaurus rex*, the very emblem of predation, the killer of killers, was actually just a scavenger, an eater of the dead. An overgrown turkey vulture! Those banana-size teeth weren't for ripping live flesh, says Horner, they were for crushing the bones of a carcass. This is vintage contrarianism, and Horner so far has failed to persuade many of his peers, who point out that *T. rex* need not have been



But perhaps the very glamour of dinosaurs has spawned the backlash, the willful retreat to scientific basics by Greg Erickson and researchers like him. Most scientific disciplines aren't caught in the gravity well of public fascination. If you study fossil mollusks, for example, you aren't likely to be asked to become a scientific adviser for a Hollywood blockbuster. No one has snail fever. But dinosaur fans are insatiable for information. The new generation of scientists wants to put constraints on all the hypotheses flying around, and they think that the truth about dinosaurs—and dinosaur behavior—won't be uncovered with bones alone.

"For 20 years we've done what we call arm-waving," says Jack Horner, a legendary bone collector. "We've made hypotheses based on very little evidence. Now we're sitting down, we're saying, 'We've got all these ideas, are they real?'"

Horner can arm-wave like a champ, as he will admit. Since 1991 he's been arguing, for

one thing or another. Hyenas, for example, are scavengers one day, predators the next.

But in any case this is precisely the kind of argument that can't be won by speaking louder than one's opponents. Science requires data. Science requires that ideas be subjected to tests. And paleontology—if the new generation has its way—will be seen as a no-nonsense field, a hard science, in addition to being a thrilling subject built around the bones of large, scary animals.

"This is where we have the rhino heads and the manatee heads," Lawrence Witmer is saying. "We've got a whole bin of ostrich heads and necks. We've got ducks and geese. Here's a bag of alligator parts."

We're in the deep freeze of his laboratory at Ohio University in Athens. Witmer has quite the collection of heads. They belonged to creatures that died, or were killed for some other reason, and were then obtained by Witmer for research.



told the professors he'd love to find a six-footed trackway.

I keep thinking Witmer is about to produce the horse head from *The Godfather*.

Witmer reconstructs the soft tissues in dinosaur heads. His method exploits similarities among creatures across the vastness of time. It turns out that a dinosaur of the Triassic period, 248 to 206 million years ago, had anatomical features remarkably similar to those of a contemporary alligator or seagull.

Witmer recently caused a stir when he said that artists had long put the nostrils of dinosaurs too high on the head. He spent months studying the relative positions of noses and nostrils in modern animals. He wanted to see if there is a correlation—whether the bone of the



ART BY RAUL MARTIN

nose reveals the location of the fleshy nostril. He found that as a rule there is such a correlation.

Witmer then examined fossils and discovered that in modern renditions of dinosaurs the nostrils had always been misplaced. They should be shown low on the nose, near the mouth. Nostrils in that location would heighten the animal's ability to nuzzle a potential food item and decide whether it was biteworthy.

Witmer investigated another paleontological presumption, the notion that *Triceratops* and other plant-eating dinosaurs had cheeks, like cows or horses or humans. Conventional wisdom said these cheeks were like feed bags, helping the animal chew and re-chew vegetation. Witmer, to his surprise, discovered that animals with cheeks have bone structures that are lacking in *Triceratops* and other herbivorous dinosaurs. *Triceratops*, he thinks, had something more like a bill or a beak.

The plant-eating dinosaurs may have clipped vegetation off plants with these beaks and then

swallowed the material pretty much intact. "They probably actually chewed with their stomachs," Witmer says.

The day I visited, Witmer took maybe 15 animal heads out of the freezer and arranged them on a table, a buffet from a nightmare. He explained how he dissects them to examine soft tissues and how he uses his findings to flesh out model dinosaur heads. As we talked, the heads thawed. They got rather . . . drippy. Beyond ripe. The moose head seemed particularly malodorous. "Most of these guys are past their sell-by date," Witmer said, unfazed.

A few hours later, putting the heads back in the freezer and mopping up the mess, he said,

Stranger than science fiction, these relatives of *Triceratops*—*Einosaurus*, *Pachyrhinosaurus*, and *Styracosaurus*, left to right—foraged 70 million years ago in what is now North America. Each species displays unique adult head ornaments, but all have similar basic anatomy "The cool thing is that the young from all the species look alike," says Catherine Forster, a paleontologist at SUNY, Stony Brook. "It's only when they mature that they get the different horns and spikes—possibly for some kind of sexual display."

"There's no real substitute for doing what we're doing—getting your hands dirty, rolling up your sleeves, getting out a scalpel, and seeing how these things are really put together."

Stephen Gatesy is another pioneer of the new dinosaur science and can spend days at his computer screen zeroed in on a single trochanter, the knobby protrusion on a bone where a tendon once attached. He might spend months or even years on a shoulder joint.

"I'm not ambitious enough to take on the whole animal," he told me when I visited him at Brown University.

That's a classic statement of the new science. Think of how dinosaur paleontology has been dominated by "the whole animal," by spectacular specimens, huge skeletons that can fill the entrance hall of a museum. This fellow Gatesy can get wrapped up in a single metatarsal.

A traditional dinosaur researcher might take a couple of loose dinosaur bones, stick them





## Hard-knock Lives

Living like a gladiator takes a painful toll on both man and beast. After 12 years in pro football and 28 game-related surgeries—15 on his ravaged left knee alone (above)—retired lineman Mark Schlereth now finds himself in the same league as a much injured *Allosaurus* nicknamed “Big Al.” On display at the University of Wyoming Geological Museum, the dinosaur’s skeleton bears the scars of at least 14 wounds, including a bony growth on the right foot (right) likely caused by post-traumatic infection. “This is an incredible thing for an animal to live with,” says Rebecca Hanna, a paleopathologist studying Big Al’s injuries. “It probably would have affected its ability to hunt and even to walk. That may have been why it died.”

Reflectors mark a mere fraction of the dinosaur nests smothered by a flood 80 million years ago at Auca Mahuevo in Patagonia. Luis Chiappe, at left, and Rodolfo Coria have found thousands of egg clutches, with no end in sight. Rare intact eggs have unmistakably revealed the embryos of titanosaurs.

together at the joint, wiggle them, pivot them, move them around, and pronounce, "I think they went like this." Gatesy wants to do the hard labor of figuring out how these structures evolved and affected locomotion—how dinosaur ancestors, for example, went from walking on four legs to walking on two (and apparently back to walking on four in some cases). Thrown into the mix is the stunning fact that some dinosaurs lifted off the ground entirely.

How did flight develop?

Did the first airborne dinosaurs merely glide, or did they flap?

Did the flight stroke evolve from other types of motion, such as grabbing prey or trying to elude a predator? Were they flappers before they were fliers?

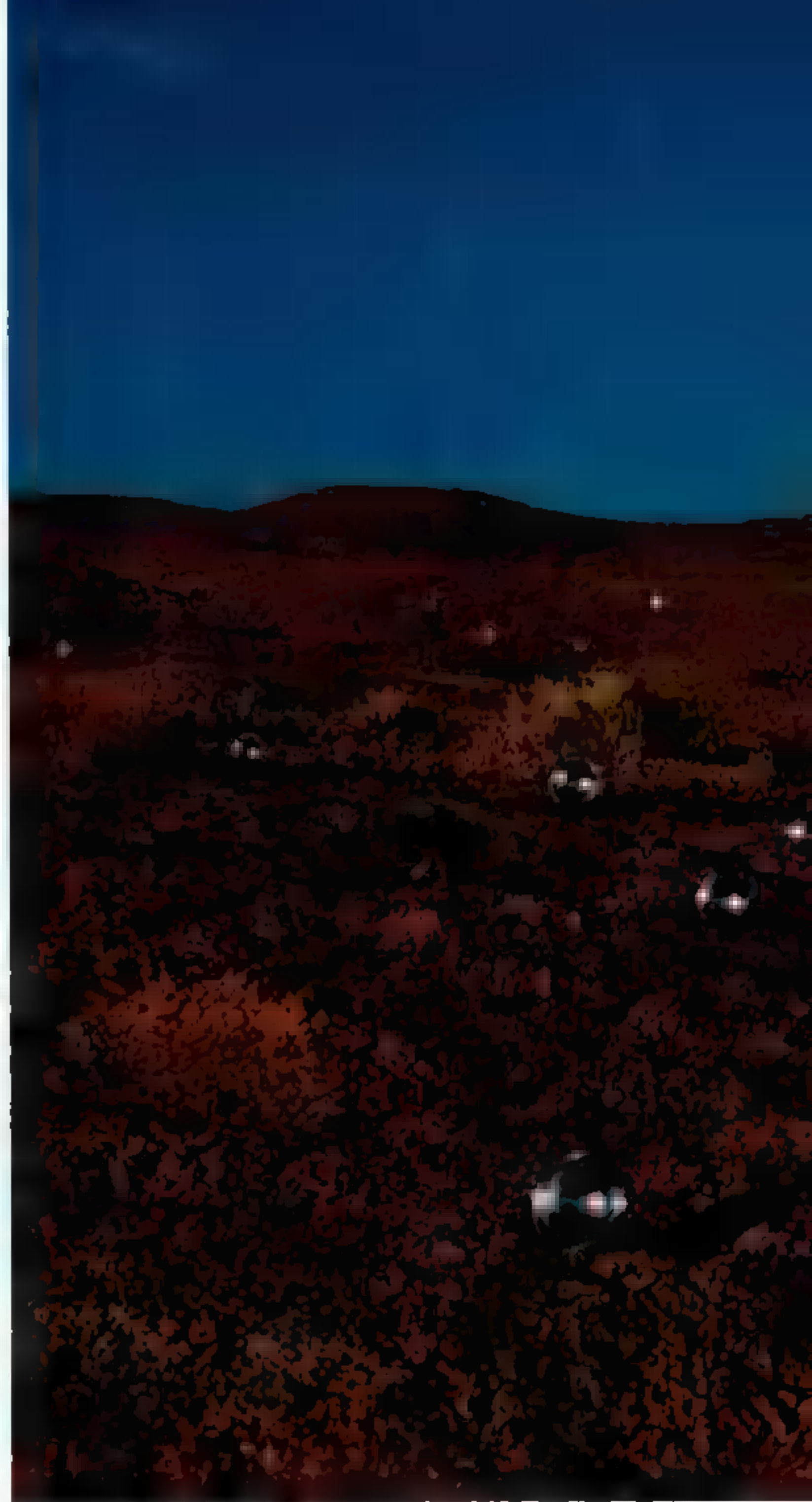
Or did flying emerge from climbing? The flight stroke might have given an animal increased traction on steep inclines. There's recent research at the University of Montana showing that baby birds, for example, start flapping when ascending an incline. They're not trying to fly, just trying to climb better.

Anatomy can be deceiving. Birds have hollow bones, feathers, wings, reduced tails, and wishbones, each characteristic designed for flight. And yet each of these traits or something like it appears in the fossil record before birds flew.

The dinosaur fossil record is actually rather poor. Intact, articulated, museum-quality skeletons are fairly rare. Fossils fall apart. A bone exposed to the elements may simply explode. In some bone beds there are so many tiny skeletal fragments you'd think the creatures had been dropped from a plane.

That's why dinosaur behavior is so difficult to fathom from just bones—why the task of understanding dinosaurs is truly like trying to squeeze blood from a stone. Some would argue that dinosaur behavior is a topic all too similar to extraterrestrial life—long on speculation and short on data.

Gatesy and other paleobiologists are struggling



to ascend what Witmer calls the Inverted Pyramid of Inference. Imagine an upside-down pyramid with, at the pointed bottom, the word "bones." Bones are the known commodity, the solid evidence. They are aged; they may be broken, cracked, ambiguous. But you can at least hold them in your hand.

Above bones on the inverted pyramid are soft tissues. There aren't many of those because they rarely fossilize.

Above that is function, how the bones and tissues worked.

Above that—so very far from the hard evidence of bones—is behavior.

Above that is environmental interaction. The dream would be to know the behaviors of many different dinosaurs and to be able to put them in context so you'd know what dinosaurs ate and where they slept and what they feared and how they prowled the landscape.

And at the very top of the inverted pyramid,



as far from hard science as you can get, is . . . well, probably the purple dinosaur known as Barney.

**D**inosaur science was inherently flamboyant and mind-boggling from its very beginning. In 1853 paleontologist Richard Owen (who had given dinosaurs their name a little more than a decade earlier) staged a celebrated sit-down dinner in London. He and 21 other scientists dined at a table set up inside a model of an *Iguanodon*. An engraving of the scene created a national sensation in Great Britain.

Bone hunters scrambled to find ever more spectacular specimens. By the early 20th century the preeminent ambition in the field was to mount a skeleton dramatic enough to scare the bejabbers out of a schoolchild.

Roy Chapman Andrews's journeys to Mongolia's Gobi in the 1920s were worthy of a Cecil B. DeMille movie—great caravans of camels stretching into the wasteland, with Andrews

packing a pistol and posing on bluffs with jaw thrust forward.

But just two decades later the heroic age of dinosaur collecting was over. Scientists began to view dinosaurs as an evolutionary dead end. They were tail-dragging losers in a Darwinian world, defeated by quicker, smarter mammals. "It is a tale of the triumph of brawn, a triumph that was long-lived, but which in the end gave way to the triumph of brain," wrote Edwin H. Colbert of the American Museum of Natural History in his 1945 publication, *The Dinosaur Book*.

The field was in the doldrums when in 1975 Robert Bakker, a maverick paleontologist at Harvard, published an article in *Scientific American* titled "Dinosaur Renaissance." It gave a shot of adrenaline to the entire discipline. Bakker, building on the work of his mentor, Yale's John Ostrom, said that dinosaurs were not cold-blooded, but rather warm-blooded, active, quick. They may have nurtured their young and



## Under Siege

**"With so many titanosaur eggs being laid, the infant mortality at Aucasaurus must have been enormous," says Chiappe, a curator at the Natural History Museum of Los Angeles County. *Aucasaurus*, a newly discovered predator from this site, may have attacked in packs, broken past the adults guarding the nests, and picked off babies as they hatched. Under these dire circumstances, fast growth aided survival. "Titanosaurs hatched with the size of a little poodle," says Chiappe. "In 15 or 20 years they grew to the size of a school bus."**





Two jaws plus thousands of other *Albertosaurus* bones found near Canada's Red Deer River add up to signs of pack hunting. Younger, faster animals likely ran down the prey, says Philip Currie, a curator at the Royal Tyrrell Museum in Alberta. With a nastier bite, adults then moved in for the kill.

hunted in packs. And they weren't even extinct! Birds, Bakker said (again, echoing Ostrom), are themselves the direct descendants of dinosaurs.

The new image carried the day. In the *Jurassic Park* movies the dinosaurs are fully Bakkerian. They sprint across meadows. They nurture their young. The "raptors" are so savvy they seem on the verge of inventing spaceflight.

"I'm a method paleontologist," Bakker said one day in Boulder, Colorado. He means like a method actor—like Robert De Niro or Marlon Brando. "I want to be Jurassic. I want to smell what the megalosaur smells, I want to see what he sees."

From a cigar box on the table he pulled a *T. rex* tooth. "This is a bullet," he said. A fossil site is a crime scene, he explained, and the teeth are the bullets. He thinks he's found evidence in the teeth of allosaurs, meat-eaters of the Jurassic, that those dinosaurs dragged huge prey to their nests to feed to their babies. As he puts it, "You're under care. Your first meal is given to you, and it's steak, and it's six feet thick."

Since Bakker's been theorizing about dinosaurs for more than a quarter century, I asked him if he thought dinosaur paleontology has become a more rigorous science with its new emphasis on lab work. He replied by citing an 1822 study of Ice Age hyenas by the Reverend William Buckland. Bakker says Buckland's work is as good as any modern paleontology. The profession looks at history, Bakker says—at the narrative of the rocks and bones. It can't possibly turn into a laboratory science.

"People who don't understand paleontology try to make it physics," he said. "Paleontology is history. It is made up of millions and millions of crimes. There are victims and there are perps."

Meanwhile, back at the lab. . . .

John Hutchinson, a 30-year-old researcher at Stanford, wants to answer a big question: Could *T. rex* run? If so, how fast? Did it have the leg muscles to sprint 45 miles an hour as some paleontologists contend?



Hutchinson doesn't think *T. rex* was that swift. He ponders *T. rex* through the prism of biomechanics. "The dream goal is to reconstruct exactly how an extinct dinosaur moved," he says. He uses a computer program that has digitized a number of *T. rex* bones.

To run that fast, Hutchinson figures, *T. rex* would have to have been almost all leg. Chickens run well, but a 13,000-pound chicken, Hutchinson has calculated, would need to have 62 percent of its mass in *each leg*.

Hutchinson also studies elephants and has made several trips to Thailand to analyze their locomotion. He paints white dots on elephants at crucial joints in the shoulders and legs. Then he chases the elephants, shouting "*Bai, Bai!*" which means "Go, Go!" In videotapes he captures the movement of the white dots.

What Hutchinson sees in the tapes doesn't look like running. At least not exactly.

"The best definition of walking is that the





body swings over the leg like a stiff, inverted pendulum. Running is very different. It's like a pogo stick, a bouncing ball. Instead of the leg being stiff, it compresses like a spring. So you're using that spring to keep running efficiently. The spring stores energy."

There are a couple of intermediate forms of locomotion, including what has been called the Groucho run, named after the bent-legged walking that Groucho Marx made famous.

Elephants are more on the Groucho side of things. They keep at least one leg on the ground at all times—like a walker—but the white dots move down then up, indicating a bouncing gait.

Hutchinson showed me how to use his computer program to move muscles around, to attach them at different places on the bones, altering the leverage. By playing around, I'm pretty sure I created a dinosaur that couldn't do much of anything but fall over backwards.

"I could spend all my life on this, analyzing

every little data point," he said. "You have to have very well-defined questions, or else you'll just get submerged in data and never get anywhere."

**T**here's another way to observe dinosaur behavior, and it doesn't involve bones or computers. Dinosaurs left tracks.

One summer day I checked out some dinosaur tracks at an abandoned mine in the Rocky Mountain foothills near Grand Cache, Alberta, Canada. I was with Rich McCrea, a 33-year-old doctoral candidate at the University of Alberta, who has scrambled over almost every square inch of exposed rock.

McCrea likes tracks. He says they're the closest he can come to live dinosaurs without using a time machine. When he presented his master's thesis, he jokingly told the professors he'd love to find a six-footed trackway. You know, two dinosaurs mating. Reptilian passion captured in stone. The professors were not visibly amused.





## The Straight Poop

Seventeen inches long and about two and a half quarts in volume, a 65-million-year-old coprolite, fossilized feces, scooped up in Saskatchewan, Canada, is one of the largest such deposits known from a carnivorous dinosaur. "It's not pretty, but it's pretty exciting in terms of what it means," says Karen Chin, a University of Colorado paleontologist. Size, age, composition, and place all point to *T. rex* as the producer. Studying a section with a microscope, Chin has identified bones from a meal—certainly a dinosaur and probably a young herbivore. The fragmented bones offer solid clues to how *T. rex* may have fed: shattering limbs, tearing at flesh, and chomping up mouthfuls before it swallowed (left).



The fact is, most dinosaur footprints capture a mundane activity: walking. In one direction, usually. One of McCrea's associates jokes that, to judge by most dinosaur tracks, these creatures couldn't turn.

The mine is at the end of a dusty road that until recently was heavily used by coal trucks. The miners sliced off a chunk of a mountain, and there's a wall of stone more than two miles long. At first you might not notice the prints. Then you see one or two, clearly outlined on the rock face. Then they gradually come into focus. The rock face is covered with footprints—"totally polluted," McCrea says admiringly.

Some go this way, some go that way. There are quadrupeds and bipeds, plant-eaters and meat-eaters. Some tracks strongly suggest herding behavior, and McCrea thinks there's evidence that meat-eaters stayed clear of the deep muck of coal-producing marshes. On some of the dark rock surfaces, remnants of swampy terrain, there are only plant-eater tracks. They were probably ankylosaurs, McCrea says. "They're like Humvees, four-wheel drives."

We climbed up a seam of broken rock, feet churning through coal fragments, and on a higher rock face found some theropod tracks, footprints that quite possibly had never been seen by a human being. The mine, after all, was a fairly recent operation, and the rock faces sheer off regularly, meaning there are always new exposures. Yet after a few hours of exploring, one also sees the limits of the trackway profession. Footprints are just footprints. Other scientists have eventually given up on this site, McCrea says. "They couldn't handle the ambiguities inherent in footprint research."

A while back Steve Gatesy decoded some dinosaur footprints. He'd gone with some colleagues to Greenland—yes, even the most dedicated digital bone manipulators spend time in the field—and found thousands of tracks. They varied greatly, as though made by different species. Some tracks had an odd, bulbous structure at the end of the third digit, like a miniature volcano had erupted. What kind of feet left such odd prints?

For help, Gatesy turned to a turkey. He and a student at Brown bought one from a nearby farm and coaxed it to walk across a variety of hard and soft surfaces, including thick mud. The turkey didn't

*(Continued on page 32)*





## Bad Timing

...life-or-death struggle con-  
...ing *Velociraptor* (left and  
... *Protocer-*





## Lifting Off

In the beginning feathers had nothing to do with flight. They may have insulated the body, provided camouflage, or attracted mates. Some scientists think feathered dino's began to fly by gliding; others argue that the motion of lunging for prey became a flight stroke. New fossils from China—including this downy, 125-million-year-old earthbound dromaeosaur (right)—may add clues. At roughly the same time and place (left), flightless dino's *Microaptor*, left, and *Sinornithosaurus*, center; an early bird named *Confuciusornis*, top left and top right; and a newly discovered bird with a long, bony tail, bottom, displayed a range of features shared by modern fowl.



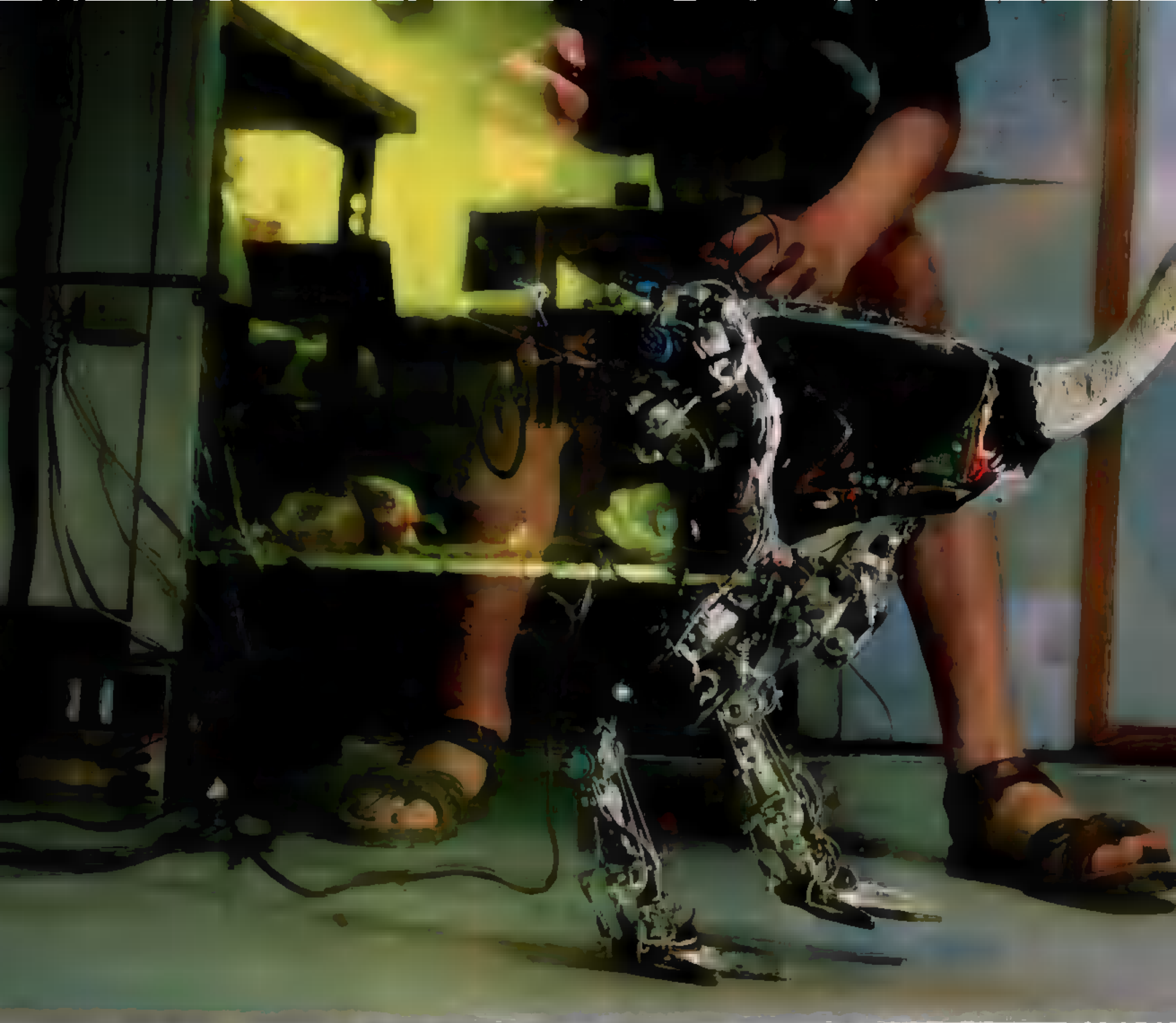
## Rocky Road

Dino tracks climb the wall of a coal mine western Canada, where University of Alberta paleontologist Rich McCrea traces a print that a two-ton, two-legged allosaur-like animal left in wet sand a hundred million years ago.

"This mine is one of the top ten track sites in the world," says McCrea. More than 10,000 footprints may be preserved in his study area alone. With 1,232 already mapped, he can see a pattern: Heavy carnivores with narrow, birdlike feet stayed on the firm sand. Herbivores with feet as broad as snowshoes plodded into swampy areas nearby to graze.







(Continued from page 26) much care for this, but the tracks it created offered a revelation: All those different dinosaur footprints could have been made by the same species. What varied was not the type of animal but the type of surface.

And that odd, volcanic shape at the end of the third digit? The turkey and the mud explained that too. As the foot goes into the goop with toes spread, it makes the initial footprint. It strikes the hard subsurface then lifts again, bunching like a closed fist. The entire foot emerges from the muck at the front of the track, creating a craterlike exit mark.

It's arcane, to be sure, but science is often nothing more nor less than deconstructing what we're staring at.

**T**he ultimate dinosaur behavior was the act of going extinct. And the mystery of that event has hardly been solved.

There's the easy, unsatisfactory answer: An

extraterrestrial impact wiped them out. Quick, brutal, efficient. In documentaries there is the obligatory scene of the great impact, a flash of light, a blast wave, and the dinosaurs blowing away like leaves before a storm.

But that can't be the whole story.

Philip Currie, his mind 75 million years in the past, roams the valley of the Red Deer River in Dinosaur Provincial Park in southern Alberta. He's the quintessential field scientist, and he's been hauling dinosaurs out of the badlands here for more than a quarter century.

I spent a day with Currie, stumbling over loose sandstones and mudstones, while he somehow remained perfectly upright, as though equipped with gyroscopes. It's not an easy workplace. Once a lightning bolt hit 30 feet from Currie and left a smoking crater in the sand. Rain turns the surface to grease. A person can get lost in about three minutes. One of his top technicians bounced out of the back of a pickup—



A new generation of dinosaurs debuts with Troody, a walking robot inspired by *Troodon*. Strutting across an MIT lab, she passes a *Protoceratops* in the works. Their creator, Peter Dilworth, plans more, covered with artificial skin. "It's a chance," he says, "to let people see the varied forms life took over the eons."

farther up the river, where the rock is 65 million years old, the last years of the Cretaceous period show only a few types of dinosaurs, including *T. rex*, *Triceratops*, and *Ankylosaurus*.

So even before dinosaurs became extinct, they were disappearing in this part of the world. That is why it's so important for the discipline to go beyond the bones and truly understand these creatures and their environment. Something triggered a tremendous decline in biodiversity. The big impact may have been merely the final blow.

The end of the Cretaceous was a time when the global climate was changing and the sea level dropping. A shallow sea that covered the heart of North America drained. Lands that were formerly separated by water were now connected. New species arrived, perhaps carrying deadly microbes.

No wonder it's such a haunting scenario. Our world today is undergoing a climate change, a period of emerging pathogens, a rapid mixing of Earth's biota, a loss of biodiversity, and a virtual shrinking of the entire planet.

Currie and I passed the afternoon in a remote part of the park, looking for new bone beds. We came upon a hillside covered with fragments, including some preserved inside unusually large nodules of ironstone. "Weird and different," Currie declared as he took a satellite reading of our position. Bone bed 185, he named it.

It might yield some answers. Or it might yield nothing but shoulder bones—the kind you look at for a second, then toss over your shoulder. But it was still exciting, because what we don't know about dinosaurs is far more than what we know. No matter how you practice it—with shovels or computer programs, with fossils or rhino heads from a freezer—this is still a new and evolving science. We've just scratched the surface. □

a long story involving a misadventure at a saloon—and wandered all night while his colleagues looked for him in ditches along roadways. To treat himself to a fancy dinner, Currie goes to a bar in the town of Patricia—a community that looks like it narrowly escaped extinction itself.

Summers in this valley bring a bumper crop of knowledge. In one bone bed Currie found the skeletons of scores of centrosaurs. From the way the bones lay, it was clear to Currie that these creatures had died in water, and he inferred that they'd panicked while fording a swollen river. "This is probably the bone bed that got people talking about herding in a serious way," he said.

Currie has so far found 35 different species in Dinosaur Provincial Park. Farther up the Red Deer River, at Drumheller, where the fossils are around 70 million years old, there have been only about 20 species of dinosaurs found. And

#### WEBSITE EXCLUSIVE

Watch footage of this issue's cover shoot; find more photographs, tales from the field, and additional resources and links at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).



Pride in their own lone star has Puerto Ricans flying—and wearing—their flag everywhere, as in this parade in Ponce. Such patriotic displays don't mean that all agree on their island's future. Residents question whether Puerto Rico should stay a U.S. commonwealth, become the 51st state, or seek independence.

# true colors

D I V I D E D   L O Y A L T I E S



BY ANDREW COCKBURN    PHOTOGRAPHS BY AMY TOENSING

**I N P U E R T O R I C O**



**A window of opportunity** opened for José Victor Colón when he bought a house in



**Santa Isabel's federally subsidized Portal de la Reina development. This stretch of tidy new homes is safer for his children than his old barrio. Such housing—affordable and close to the interstate—is drawing young families away from Puerto Rico's small towns.**

**T**he rum bottle in front of him almost empty, Jacobo Morales is approaching the end of a rambling stage monologue on what it means to be Puerto Rican. Earlier he had toasted “the great American nation, of which I’m proud to be a citizen.” But with this most recent toast his mood has turned militantly nationalistic: “What I am is Ameri . . . *Puerto Rican!*” And then another turnabout. “Puerto Rican *and* Ameri. . . . What I am is a *realist,*

## Meanwhile, much of the Puerto Rican landscape is

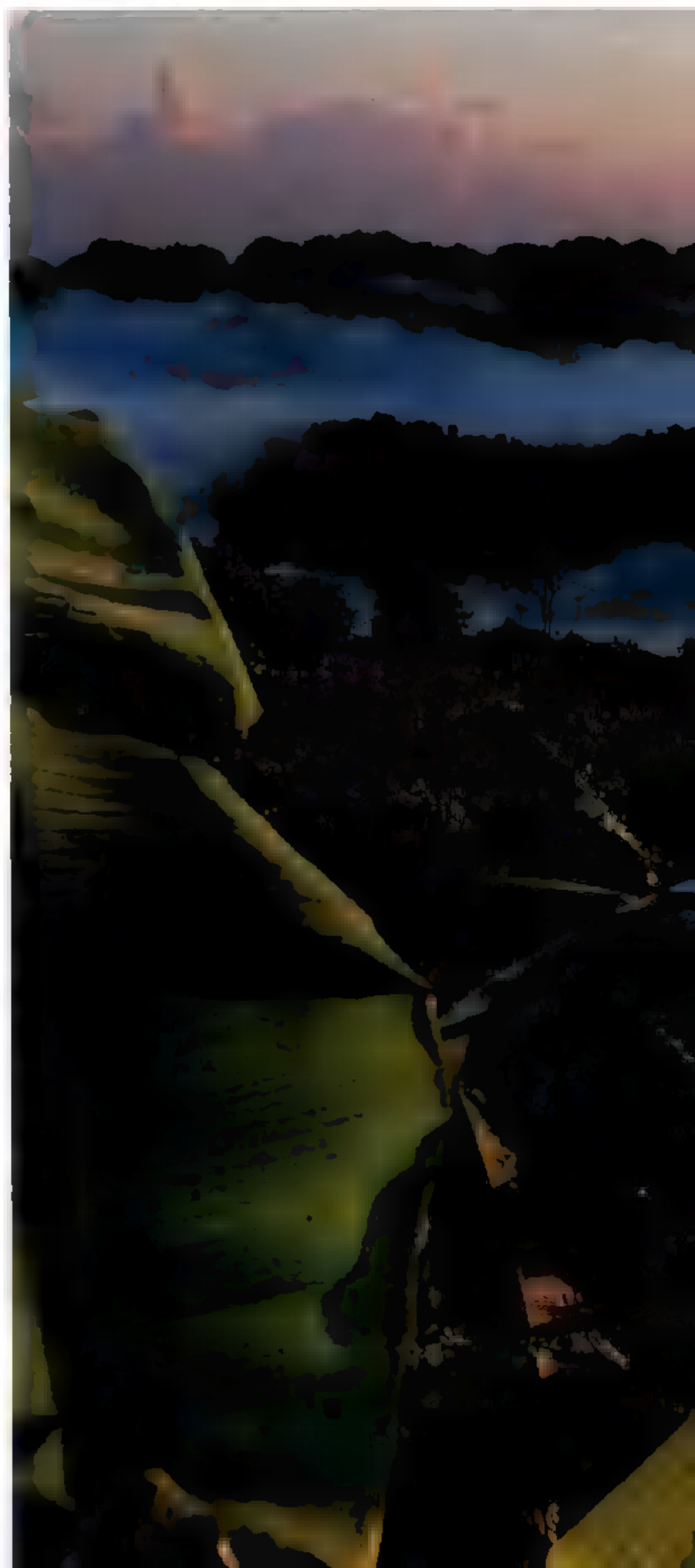
because one thing is what I feel, another is what’s convenient. What I feel is Puerto Rican first and Puerto Rican always—but what about the welfare checks?” Finally, polishing off the last of the bottle, Morales makes up his mind, shouting: “*Viva Puerto Rico libre!*—Long live free Puerto Rico!”

In reality, Jacobo Morales is not a boozy bar-room philosopher, but Puerto Rico’s leading film director as well as a member of Los Rayos Gamma, the Gamma Rays—a group of old friends who have turned themselves into a political satire group. “The last line always brings the house down,” he says happily. “I am speaking as Juan del Pueblo [the local equivalent of Joe Sixpack] but even a middle-class audience in San Juan will cheer the idea of independence. Inside, all Puerto Ricans feel very nationalistic about their island, even if they don’t vote that way.”

“That’s why we close the bars on election day,” a government official in the capital of San Juan noted cynically as we discussed Morales’s performance. “Otherwise the whole country would vote for independence.” As it is, with sobriety enforced, Puerto Rico is, and has been since the birth of its constitution in 1952, a commonwealth, meaning, in effect, it is a semicolony of the United States.

Puerto Ricans are U.S. citizens, although island residents do not vote for President or

**Dancing fans** of plantain leaves wave in mountainous Utuado, where Edwin Vidal’s 67-acre plantation produces two tons of the staple fruit each year. Because farmland is scarce on this crowded island, most plantains eaten here must be imported. Vidal would like to change that: “We should grow our own.”





pay federal income taxes; they have only nonvoting representation in Congress. The U.S. government takes care of defense and foreign affairs and foots the bill for welfare (for which almost 60 percent of Puerto Ricans qualify). Otherwise, Puerto Rico exercises self-government in local affairs.

Despite 50 years of the status quo, the electorate's passionate interest in debating the issue of the island's relationship to the United States has continued undiminished. Turnout on

election days remains steady at around 85 percent (although much of the fervor may come from the fact that thousands of government jobs, which account for one-third of the island's total workforce, can be at stake when one party replaces another). Currently the party favoring the present commonwealth status has a growing margin over the party demanding Puerto Rico's admission as the 51st state. Nearly 5 percent champion full independence from the United States.

**disappearing under concrete as construction spreads.**





The debate invades conversations in the most unlikely places, as I discovered in talking with Luis, a heroin addict who assured me earnestly that the high price of his fix compared to what he would pay in New York was “another example of the unfair trade relations between Puerto Rico and the U.S.”

I gained this unusual perspective on U.S.–Puerto Rican relations at an addicts’ shooting gallery in La Perla, a self-contained community perched on a steep slope between the shoreline and the massive 17th-century

fortifications of Old San Juan. This is a place where police seldom venture and that outsiders are warned to avoid. Luis pointed to the jagged rocks below, where unfortunates who break the internal laws of the community, such as robbing a neighbor, have ended up. “We are,” he said with a note of pride in his voice, “an island within an island.”

There are many cultural islands within Puerto Rico. Though its four million or so inhabitants are crammed into a space only a hundred miles long by 35 miles wide, the society exhibits an

**Parrot-bright** socialites flaunt their plumage during a San Juan polo match. Most Puerto Ricans live a far less lavish lifestyle; per capita income is less than \$9,000. On Isla Verde beach (left) a building boom has spilled to ocean's edge. Puerto Ricans themselves are almost as tightly packed: About four million people crowd the 100-mile-long island (map), one of the most densely populated in the world.

impressive degree of diversity. They even call the same thing by different names: In San Juan, sprawled along the island's northeast coast, a nickel is a *vellón*. In the mountains that run east-west through the center of the island, it is a *ficha*. Loíza, a town east of San Juan and populated largely by the descendants of African slaves, is the hub of the distinctive *bomba* music and dance, but there are no fewer than 13 variations of bomba on the island.

Local pride is fierce. A few years ago the people of Cabo Rojo, a small western town, got a law passed that allows them to claim Cabo

have left behind when they fled Castro. Now people tell jokes about Dominicans," most of whom arrive as boat people across the Mona Passage from Santo Domingo and provide the menial unskilled workforce, "about how dumb they are, like the Polish jokes you used to have in the States."

San Juan itself is an ever expanding island, its suburbs steadily creeping up the slopes of the inland mountains. And at the heart of the metropolis Old San Juan is yet another enclave, blocks of graceful row houses along streets paved with cobblestones that arrived as

ballast in galleons at the beginning of the 16th century. This antique gem is carefully preserved as a beguiling relic of the 400 years when the island served as an outpost to guard Spain's American empire.

**I**t was during the centuries of Spanish control that Puerto Ricans coalesced as a people—an intermingling of the original inhabitants, the Taíno Indians (long gone, although mitochondrial DNA tests recently revealed that more than

60 percent of Puerto Ricans alive today have a Taíno ancestor), with the descendants of the Spanish settlers and their African slaves. Early in the 19th century the Spanish government, alarmed by nationalist rebellions among colonial Spaniards elsewhere, advertised for non-Spanish white Catholic settlers, and thus added numbers of Irish and Corsicans to the mix.

"The Corsicans were smugglers," one of their descendants, journalist Juan Manuel García-Passalacqua, notes proudly, "which in any case is an old Puerto Rican tradition." Other



Rojo as their legal birthplace even if they are born in the hospital in nearby Mayagüez. Inhabitants of the southern coastal city of Ponce, which had its greatest days of prosperity in the 19th century, look down on vulgar San Juan and are considered snooty by everyone else.

Despite these regional loyalties and rivalries, Puerto Ricans do not make jokes about each other, but about outsiders. "All the jokes used to be about Cubans," explains attorney Héctor González Pereira, "about how pushy they were and about how much wealth they all claimed to



**Drumbeats drive** Gina Avilés as she sways to *bomba* music at El Alambique bar in Loíza



**The heavily percussive music originated more than two centuries ago with enslaved Africans brought in to work the local sugar plantations. "Anyone is welcome to play," says a local man of the bar's bomba night. And everyone is welcome to dance.**

traditional economic mainstays included sugar, worked by slaves on the plantations in the coastal lowlands, and coffee, grown in the central mountain ranges that shelter the arid south from the trade winds that keep the north humid and green.

As the population grew, so did its quest to gain freedom from Spain. By the end of the 19th century Puerto Ricans had finally wrested a measure of political autonomy from their rulers in Madrid—just in time for the Spanish-American

Puerto Rico's health, education, and income levels far beyond what the island had previously known. As the largesse of the 1960s Great Society programs brought prosperity to the island, it appeared that Puerto Rico might indeed be molded into a little slice of the United States, albeit with a Latin veneer.

With this rush to modernity came a corresponding tendency to jettison symbols of the island's heritage. Fifty years ago Old San Juan nearly fell victim to local developers intent on

## Old San Juan nearly **fell victim** to local developers

War in 1898. The U.S. not only took possession of the island, along with its largest plantations and sugar mills, as the spoils of war, it also embarked on a program to Americanize the locals.

"The great mass of Puerto Ricans are as yet passive and plastic," declared an official of the newly installed U.S. military government, which was replaced by a civil government created by the U.S. Congress in 1900. "Their ideals are in our hands to create and mold." Puerto Ricans were portrayed in U.S. newspaper cartoons at the time as primitive savages dressed in loincloths. All schools were swiftly provided with reading material in English, U.S. history books, and American flags. Nevertheless, Puerto Rico for half a century remained an agricultural backwater of impoverished peasant farmers.

Matters began to change in 1950 with the launch of Operation Bootstrap, an economic program that lured U.S. corporations to the island with the promise of cheap labor and attractive tax breaks. Farmers abandoned their small holdings on the slopes of the central mountains to work in new manufacturing plants, textile factories, and fish canneries springing up around San Juan and elsewhere. Others emigrated in vast numbers to New York, forming yet another Puerto Rican island offshore. Within a generation Operation Bootstrap raised

**Life and taxis** idle in the main square of Adjuntas, a central-island mountain town bypassed by the coast-hugging construction boom. Adjuntas is known as the "Switzerland of Puerto Rico" because of its chilly climate and hilly terrain. But cold is relative. The average yearly temperature in Adjuntas is 72° F.



obliterating its blue cobblestone streets and pastel row houses.

"They wanted to tear the city down and create what they promised would be a mini-New York," recalls Ricardo Alegría, founder of the Institute of Puerto Rican Culture, which played a leading role in saving the old city. "There were similar plans for Ponce," another gem of colonial architecture. "That was going to be a mini-Chicago."

Puerto Ricans appear to be withstanding

all attempts at molding them into a slice of the U.S. They have resisted attempts to turn them into English-speakers; in Hawaii, there are even families whose ancestors left Puerto Rico in the 1890s that are still obdurately speaking Spanish and eating rice and beans. Nowadays Puerto Rico is spearheading the Latin invasion of American popular music, thanks to the international success of stars like Ricky Martin, Marc Anthony, Jennifer Lopez, and the group *Plena Libre*.

**intent on obliterating its blue cobblestone streets.**





In sporting events and beauty pageants—the only international venues in which Puerto Rico participates as an independent nation—success takes on extraordinary importance. When, in May 2001, Denise Quiñones became the fourth Puerto Rican to win the Miss Universe title, the whole island erupted in a frenzy of nationalist exhilaration. Cheering crowds waving the Puerto Rican flag blocked the streets of San Juan for hours. The next day, when local boxer Felix “Tito” Trinidad won a world middleweight boxing championship, celebrations erupted all over again. At a Trinidad victory rally in 2000, fans forced organizers to remove the U.S. flag from the stage. “This is our victory,” they shouted.

In the past, flaunting the Puerto Rican flag could be dangerous—“my wife was pulled over in the 1950s for displaying a flag sticker on her car,” remembers journalist García-Passalacqua—but it is something Puerto Ricans now do with abandon. Visiting the island in the wake of the September 11 terrorist attacks, when the entire U.S. seemed festooned with the Stars and Stripes, I found it strange to see Old Glory relegated almost solely to government buildings while the single star of the Puerto Rican flag sprouted from

offices, cars, and homes everywhere. Now even the Statehood Party features the Puerto Rican flag in its TV ads.

**T**wo flags fly in front of a modest wooden chapel near an old Spanish fort in San Juan—one the Stars and Stripes, the other the flag of Puerto Rico. The chapel is a reproduction of one built on Vieques, an island 21 miles long and 4 wide off the east coast of Puerto Rico. The protesters who built the original chapel were demonstrating against the U.S. Navy, which, in 1941, expropriated two-thirds of Vieques for a base and bombing range.

The Vieques chapel was torn down by the Navy, so the protesters erected its twin in the capital, complete with a defiantly large Puerto Rican flag. Militant supporters of statehood tore that flag down and replaced it with the Stars and Stripes. Now, in a compromise resolution to the standoff, the two pennants flutter side by side in uneasy proximity.

The national uproar over the use of Vieques for U.S. military target practice, however, transcends disagreements about flags—and continues despite a promise by the U.S. to vacate the Navy installation by May of this year.



**Masked for anonymity,** lawyer Fermín Arraiza Navas (below) drove a speedboat into a U.S. Navy bombing site off Vieques Island in 2002 to protest weapons testing. He was arrested and served 20 days for trespassing. “More than 1,500 persons have been prosecuted for defending the right of Viequenses to live in peace,” he says. Swayed in part by peaceful protests (left), the Navy has promised to leave the island this year.

For years, Vieques residents, known as Viequenses, protested the bombardment of their island without effect. Then, in April 1999, a U.S. Marine Corps FA-18 fighter missed its target by a mile and dropped two 500-pound bombs close to the range observation post, killing a local civilian security guard named David Sanes.

Outrage swept Puerto Rico. By February 2000, a march in San Juan drew 150,000 people. In November 2000 Sila Calderón was elected governor of Puerto Rico after vowing to stop the Navy bombing. The island’s leading musicians collaborated on a joint CD devoted to

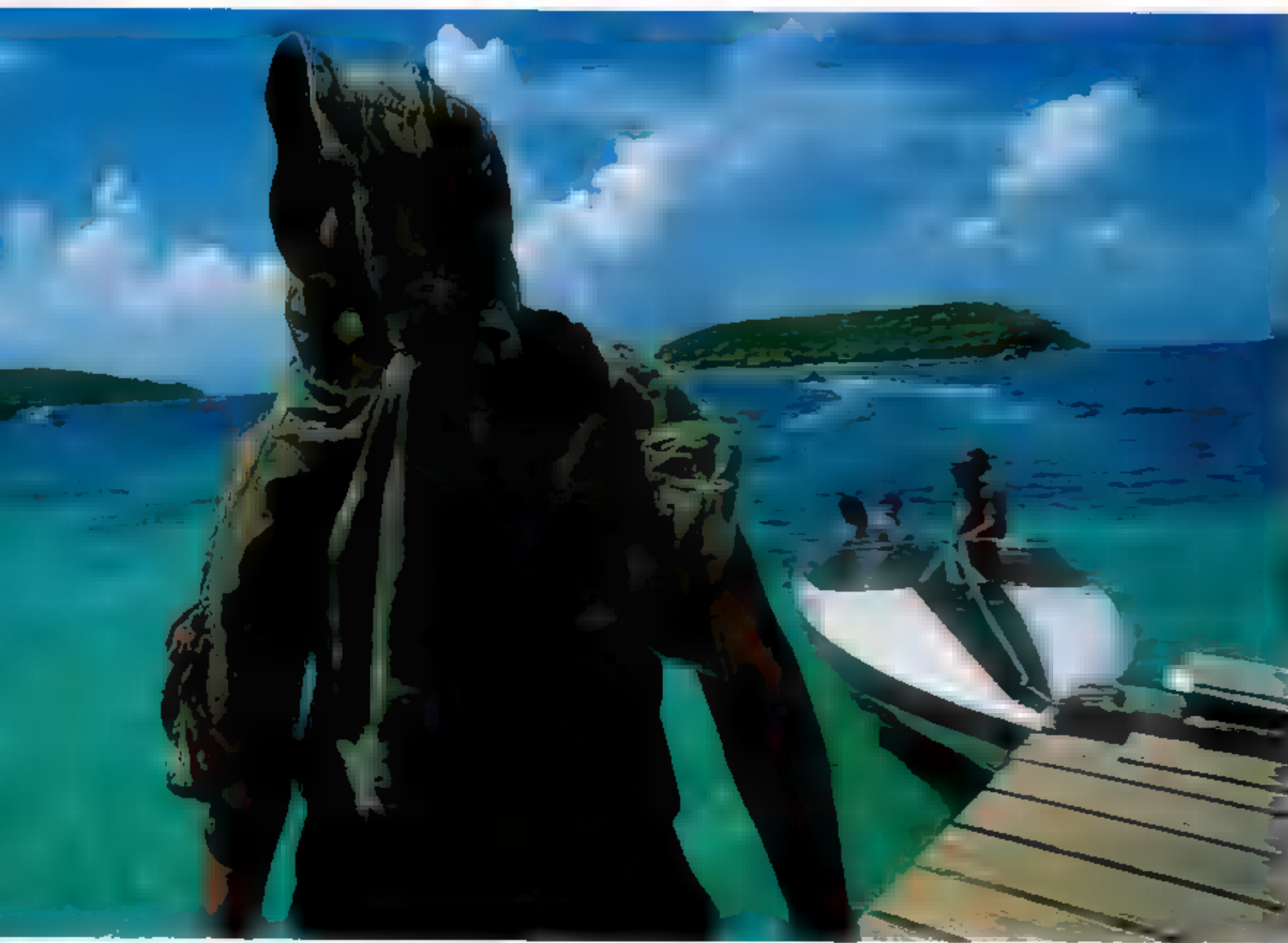
Vieques to be arrested—and sentenced to increasingly harsh prison terms—including many leading lights of the Puerto Rican diaspora in the U.S. This diaspora may soon outnumber the island population, and their electoral potency might account for the Bush Administration’s promise to halt military operations.

**A**mong those who have been arrested on Vieques is Dr. José Vargas-Vidot, an engaging, rotund 48-year-old community activist. Vargas-Vidot has been working with the very bottom tier of Puerto Rican

society for 15 years. In 1997, in the course of a government-sponsored survey, he discovered that no less than 40 percent of the people he tested in a rough area on the outskirts of San Juan called Cataño registered positive for HIV. Concluding that a needle exchange program for addicts might help prevent the spread of the disease, he began supplying clean syringes and treating the inmates in squalid heroin shooting galleries at various insalubrious spots around the island (it was Vargas-

Vidot who took me to La Perla on the rocky heights above San Juan), using money he either raised himself or cajoled out of a generally indifferent government.

In spite of the outward appearance of escalating national pride, Vargas-Vidot laments what he sees as a debilitating deference toward the U.S. on the part of many Puerto Ricans. “For a hundred years people have been used to the rules coming from the U.S. There’s always a sense that someone is watching us, that we must be obedient to that great voice. Our

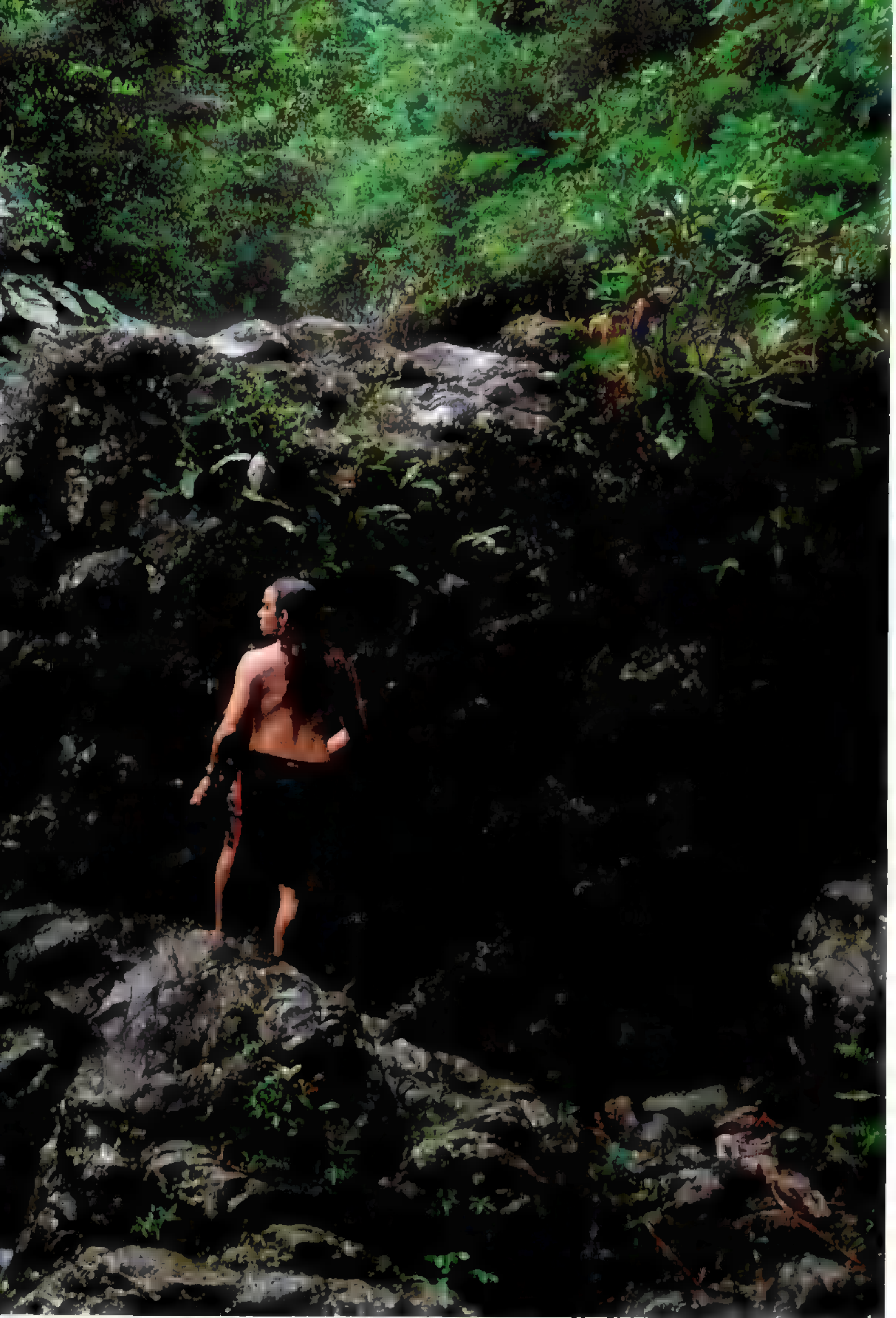


the cause of Vieques. Dozens of Puerto Rican veterans returned their medals in a box to the White House. “I spent a year in a combat zone,” wrote Luis Ramos, now the Puerto Rican government’s veterans liaison, in a letter to the White House. “It changed my life forever. The children of Vieques have been in a combat zone since they were born. You must put an end to that.”

The ferment generated a civil disobedience movement among Puerto Ricans of all political persuasions. Those who made pilgrimages to



**A rain forest escape** refreshes city dwellers Aura Broida (midair) and Rolando Silva in th



**Caribbean National Forest, also known as El Yunque. Just an hour's drive from San Juan, El Yunque is the only tropical rain forest in the U.S. Forest Service system, and one of the oldest reserves in the Western hemisphere. It was first set aside by the King of Spain in 1876.**



fathers think of the U.S. as bringing prosperity.”

Vargas-Vidot experienced this generational split in his own family. “My father spent four years in the U.S. Navy and another eleven years in the Army, and when I got arrested on Vieques he didn’t speak to me for four months. My parents love me but. . . .” He grinned ruefully.

When I paid a call on the senior Vargas, he was ebulliently hospitable and refused to be drawn into any criticism of his son’s political activities: “I go with my boy. Whatever he does is all right by me.” But then he went on to express his affectionate memories of military service and his loyalty to the United States. “If Puerto Rico ever became independent, I’d move to the U.S. This place would be bust in a minute—no more Social Security, no more checks every month.”

Advocates of independence have always had to contend with the arguments of people like the elder Vargas, notwithstanding the fact that 50 years after Operation Bootstrap began to gather speed, Puerto Rico’s per capita income is about half that of Mississippi, one of the poorest states in the union.

The initial success of Operation Bootstrap owed much to a special provision of the federal

tax code, section 936, that excused taxes on U.S. corporate profits earned in Puerto Rico. But Congress began phasing out section 936 in 1995, and now factories are decaying around the island. Similarly, the petrochemical industry that grew up in the 1960s depended entirely on a quirk favoring Puerto Rico in U.S. oil-import regulations. That advantage disappeared in 1973, and today the rusting towers of the petrochemical plants, stretching for miles beside the coastal highway west of Ponce, are monuments to the difference the stroke of a pen in Washington can make.

**S**uccessive local administrations have striven for economic alternatives. Just outside Ponce the fine surface of Highway 10 winds smoothly up into the mountains to the picturesque town of Adjuntas, in the heart of coffee country. The road is there because in the 1970s U.S. consultants conceived another scheme, called Plan 2020, for the economic regeneration of Puerto Rico.

Key to the plan was the discovery of rich deposits of copper and other minerals under the peaks that loom over the town. Ore would be trucked down the new road to be processed

**Heroin grips users** in Loíza Aldea. Many addicts there benefit from a needle exchange and other services offered by the group *Iniciativa Comunitaria*. Because of work by organizations like these, people with HIV are getting treatment and living longer. Also in Loíza Aldea, a Palo Mayombe priest performs a sacrifice (below). The religion, based on African Yoruba beliefs, arrived with the slave trade.

and then exported through a megaport to be built at Ponce. U.S. copper companies prepared to clear-cut the mountain that was designated to become an open pit mine a mile wide and 2,000 feet deep, promising jobs, a baseball stadium, and a lake once all the ore had been removed from the pit.

While politicians enthusiastically endorsed the plan, a small group of local people pondered the imminent destruction of their environment in exchange for, they discovered, just 200 jobs. They formed a group named Casa Pueblo and resolved to fight.

by Puerto Rican police intelligence to report on Casa Pueblo's activities year after year, an indication of how deadly serious some of Puerto Rico's politics have been in the recent past. Well into the 1980s the local police as well as the FBI secretly monitored large sections of the population deemed to be potentially subversive. When the Puerto Rican supreme court finally called a halt to the surveillance in 1987, there were 150,000 files steadily filling up with the details of people's personal lives—as a horrified public discovered when the files were handed to their subjects.

These days, says García, Casa Pueblo has moved on to try and create something, "instead of just being negative." She and her colleague Inés Sastre de Jesús took me up muddy trails to show me the forest they are tending on land reclaimed from the mining companies.

Mist swirled among the peaks, drifting over thickly wooded slopes originally denuded by *jitbaros*—farmers—who left in the 1950s to live and work in the crowded projects of San Juan and the Bronx. The woods

have grown back, giving the landscape the appearance it must have had when this was the heartland of the Tainos, a collection of whose stone carvings are respectfully laid out nearby.

Meanwhile, much of the Puerto Rican landscape is disappearing under concrete as construction—frequently without benefit of zoning regulation—spreads in ever thickening clusters. Endless ranks of malls and factory outlets line the island's highways, increasingly clogged by *tapones*, traffic jams



In an Adjuntas backstreet, Giovanna García, just born when the debate began, showed me around the permanent exhibition that Casa Pueblo maintains at its headquarters. The exhibit chronicles how the group slowly mobilized support, first in the town and eventually across Puerto Rico, until, in 1995, the government abandoned the project in the face of an unprecedented grassroots movement.

Most of this history was quite precisely detailed in a file that García showed me. It contained the full reports of informers assigned



**A personal sound track** of guitar, maracas, and waves accompanies the evening in



**Aguadilla, at Puerto Rico's northwestern edge. From drum-and-guitar *jibaro* folk songs to invigorating salsa rhythms to the classical cello of Pablo Casals, music is everywhere on the island. Says one Puerto Rican, "If you come from here, it's a part of you."**

(“Our new neighborhoods,” according to artist Carmelo Sobrino, who has started painting them).

Clearly there is a disparity between these signs of prosperity and dismal economic statistics, such as the bulging welfare rolls. Cheerful assurances that “we all live on plastic” didn’t sound like the whole story. The U.S. Drug Enforcement Administration estimates that as much as 20 percent of all the cocaine entering the States comes through Puerto Rico or the U.S. Virgin Islands (these islands have

informal, meaning that it is based on cash that goes undeclared for one reason or another. “A third?” answered Stipes. “I don’t think so.” I waited for him to come back with some reassuringly lower figure. “I’d say the true figure would be around 50 to 55 percent,” he declared confidently.

This flood of so-called black money, Stipes was anxious to emphasize, is not due to traffic in drugs, prostitution, or illegal arms. “It’s just that in Puerto Rico people either don’t file a tax

## When Denise Quiñones became the fourth Puerto

the dubious advantages of a long coastline and, of course, no customs barriers with the mainland). San Juan is designated as one of just six High Incidence of Financial Crime Areas in the United States, up there with New York, Los Angeles, and Chicago. Elías R. Gutiérrez, an economist at the University of Puerto Rico, says that the island’s illegal drug trade may eclipse its legal pharmaceuticals business: “Our illegal drug export earnings now match the legal variety,” comments Gutiérrez, “I’d say we are in trouble.”

Frank Stipes, head of Westernbank, a fast-growing regional bank based in Mayagüez, had no trouble confirming my observation that there seemed to be a lot of money about. Puerto Ricans’ aggressive spending habits seem to guarantee that, for example, the San Juan Mercedes dealership is one of the most successful in all of Latin America. “The reality is that the economy is much stronger than the numbers indicate. This is due to a strong, and I mean *very* strong, ‘informal’ economy.”

I cautiously remarked that I had heard that as much as 33 percent of the economy might be

### WEBSITE EXCLUSIVE

Keep the status quo, declare independence, or become the 51st state? Share your thoughts in our online forum. You’ll also find more images and notes from the field at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).

**A newly grown up** Jessica Vásquez of Guayama readies for her *quinceañera*, the coming-of-age party for 15-year-old girls. After 51 years as a commonwealth, Puerto Rico’s bond with the U.S. is also coming of age. Now both sides struggle to determine what that relationship will be.





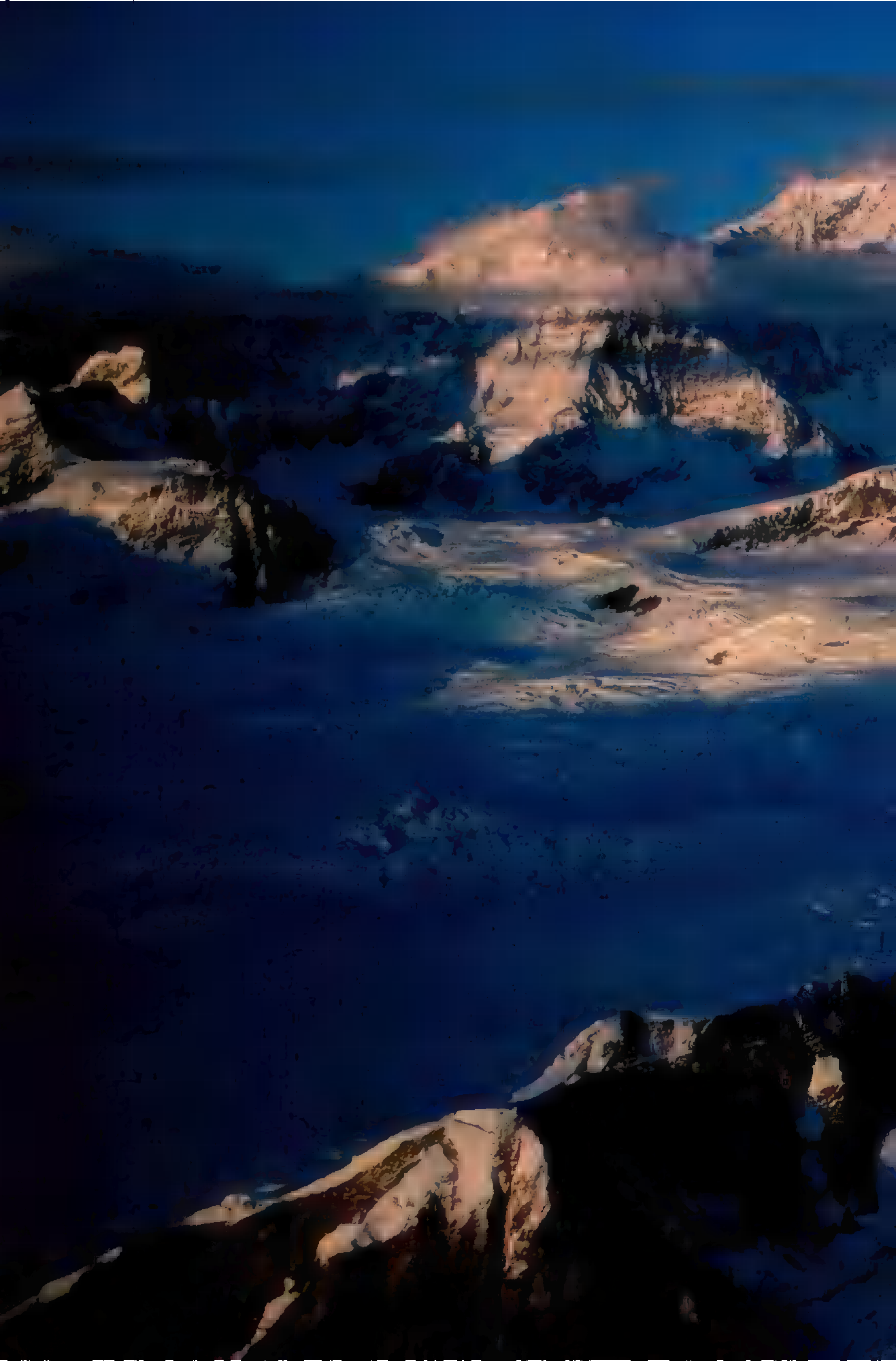
return or it's not complete. Take the Fajardo marina—a quarter of a billion dollars' worth of boats. They belong to doctors, lawyers, and engineers, not drug traffickers. Those professionals may be making \$400,000 a year, but they'll declare \$20,000."

Eventually, like most conversations in Puerto Rico, the talk turned to political status. Stipes ran through the familiar arguments against any of the available options. Congress would never grant statehood; the present arrangement,

subject to the whims of Washington, is unsatisfactory; independence would ruin standards of living. I did notice, however, that like every other Puerto Rican I talked to, the banker—who was on his way to ring the opening bell at the New York Stock Exchange and who has big plans to expand into the American market—invariably used the word "we" in reference to Puerto Rico and "they" when talking about the United States. It seemed a telling sign of a restive nation. □

**Rican to win *Miss Universe*, the whole island erupted.**







AMERICAN LANDSCAPES

FIRST IN A SERIES

# Alaska's Giant of Ice and Stone

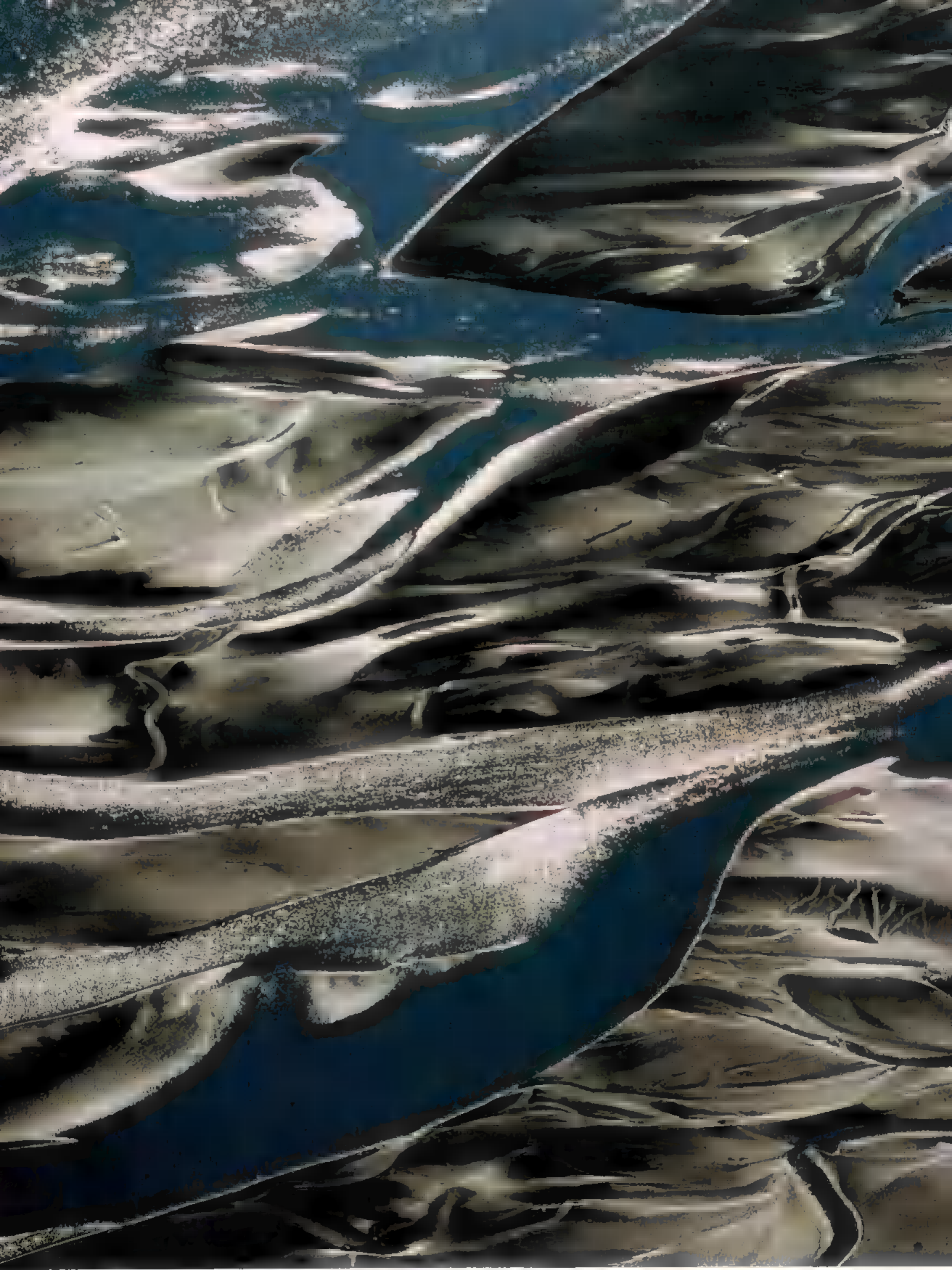
WRANGELL-ST. ELIAS

NATIONAL PARK

Grandeur on a uniquely Alaskan scale: From the 18,008-foot glacier-clad peak of Mount St. Elias (overleaf) to the silver meandering of a nameless stream (right), Wrangell-St. Elias National Park and Preserve protects more than 13 million acres of mountains, tundra, forests, ice fields—and solitude.

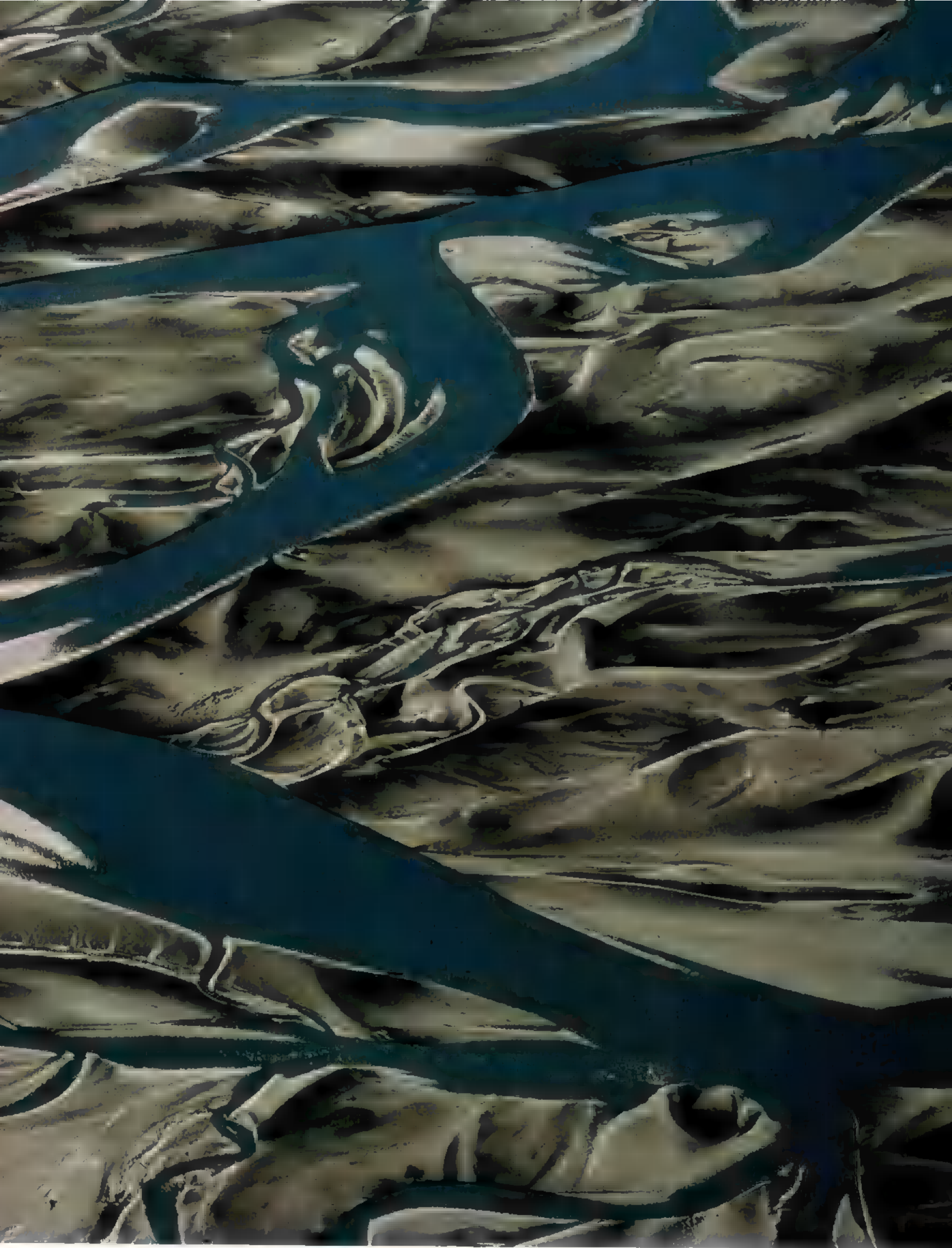






SAPPHIRE AND SILT

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*Curving and twining in lazy filigree, the Copper River sprawls through Chugach National Forest toward the Gulf of Alaska. Upstream, countless tributaries empty their burdens into its channel. Part jewel, part dump truck, the river roars through the mountains, then pours across a vast delta.*

**S**ome people like their landscapes tamed and tidy. Some folks don't. Some like them wild, remote, large, and lonely—say, like Wrangell-St. Elias National Park and Preserve in southeast Alaska. Here is a landscape that could swallow all of Switzerland. It could swallow you too, if you'd let it.

At the park's headquarters near Copper Center—four hours by car from Anchorage, five if you take some time with the roadside views—a new visitor center had just opened when I dropped by. It was empty. So was the parking lot. Over at the administration building, Gary Candelaria, the superintendent, said an accurate head count of visitors was impossible because Wrangell-St. Elias has no tollbooths or entrance fee. "We're not about numbers of visitors," he said. "We're about the preservation of natural ecosystems." Still, his best guess, for visitors, was between 30,000 and 60,000 a year. That top figure is what Great Smoky Mountains National Park might expect on a summer weekend. Moreover, a visitor can't really experience

this park the way one might driving through Yellowstone or Yosemite. There is no *through* here, only *over*. "It's a flyover sort of park," Candelaria was saying. "It's so spread out. To get any real sense of the place, you have to go up in the air."

At Glennallen, just up the road from Copper Center, charter pilot Lynn Ellis talked for a while about the scale of the place. "Once in a while," Ellis said, "we get someone who thinks you can see the whole park in a couple of hours. 'Well,' I say, 'I've got a plane that can do 140 miles an hour for four-and-a-half hours before refueling. And even then, you won't see the half of it.'"

No wonder. At 13.2 million acres, Wrangell-St. Elias is far and away the largest unit in the entire National Park System, nearly six times the size of Yellowstone. With Canada's Kluane National Park and Tatshenshini-Alsek Park next door, and the United States' Glacier Bay National Park and Preserve just around the corner, Wrangell-St. Elias and its neighbors embrace a United Nations World Heritage site that is the largest internationally protected wildland on Earth.

Four majestic mountain ranges converge here: the outliers of the Alaska Range on the north, the volcanic Wrangells—part of the Pacific Rim's Ring of Fire—merging into the St. Elias Mountains in the center of the park, and the snaggle-toothed Chugach confronting the Gulf of Alaska on the southwest. Mount St. Elias tops out at 18,008 feet, the highest peak in the U.S. after Denali. Mount Wrangell, a 14,000-footer, remains tectonically active; plumes of steam occasionally rise hundreds of feet above its icy summit.

There is no shortage of ice in the high country. Moist maritime air colliding with the coastal mountains annually deposits up to 50 feet of



ISRAEL C. RUSSELL. U.S. GEOLOGICAL SURVEY

**1890: PLAGUED BY AVALANCHES and blizzards, the infant National Geographic Society's first expedition sent U.S. Geological Survey geologist Israel C. Russell, a topographer, seven camp hands, and two dogs to explore and map Mount St. Elias.**



snow, enough to nourish scores of glaciers. The Malaspina, North America's largest piedmont glacier, sprawls at the foot of the St. Elias Mountains across an area nearly half the size of Delaware. The Nabesna, flowing north from the Wrangells, is said to be among the longest non-polar valley glaciers in the Western Hemisphere.

Gray rock, blue ice. Peak after peak, valley after valley. And wilderness—9.6 million congressionally designated acres of it, a tenth of the entire National Wilderness Preservation System right here in one largely untrodden, wonderfully untamed, magnificently underappreciated national park.

FLYING CHARTER WAS NOT AN OPTION for the early explorers who came here to put names on the emptiness of the map. St. Elias? That was Vitus Bering's contribution in 1741. The summit was the first piece of the Alaska mainland to catch the seafarer's shoreward eye. Cruising the coast, Bering named a cape on the feast day of an obscure saint, Elias. Mapmakers later sainted the mountain. A half century later Alessandro Malaspina sailed into Yakutat Bay in search of the fabled Strait of Anian—the long-sought western portal of the Northwest Passage. What he found instead was a wall of ice. So the cul-de-sac came to be known as Disenchantment Bay. And Malaspina would get his name on a glacier.

Fast-forward a hundred years and behold the May 29, 1891, issue of NATIONAL GEOGRAPHIC. Here is Israel C. Russell of the U.S. Geological Survey (and a co-founder of the National Geographic Society) with a 114-page account of the previous year's expedition "to study the geography, geology, and glaciers of the region around Mount St. Elias" and to ascend that unclimbed peak as well. It would be the two-year-old Society's first sponsored exploration, a venture personally financed in large part by its first President, Gardiner G. Hubbard. In gratitude Russell attached Hubbard's name to a 15,000-foot mountain and a 75-mile river of ice—in Russell's view the "most magnificent of the tidewater glaciers of Alaska yet discovered." And in tribute to Russell, the U.S. Geological Survey later attached his name to the fjord at the Hubbard Glacier's foot.

After two attempts under blizzard conditions to reach the top of Mount St. Elias, Russell was obliged to turn back, but his mapping of potential routes enabled an Italian duke to succeed a few years later.

About this same time, prospectors were coming into the country, lured by the promise of Yukon gold and later by the discovery of a high-grade lode of copper almost dead center in what is now *(Continued on page 70)*

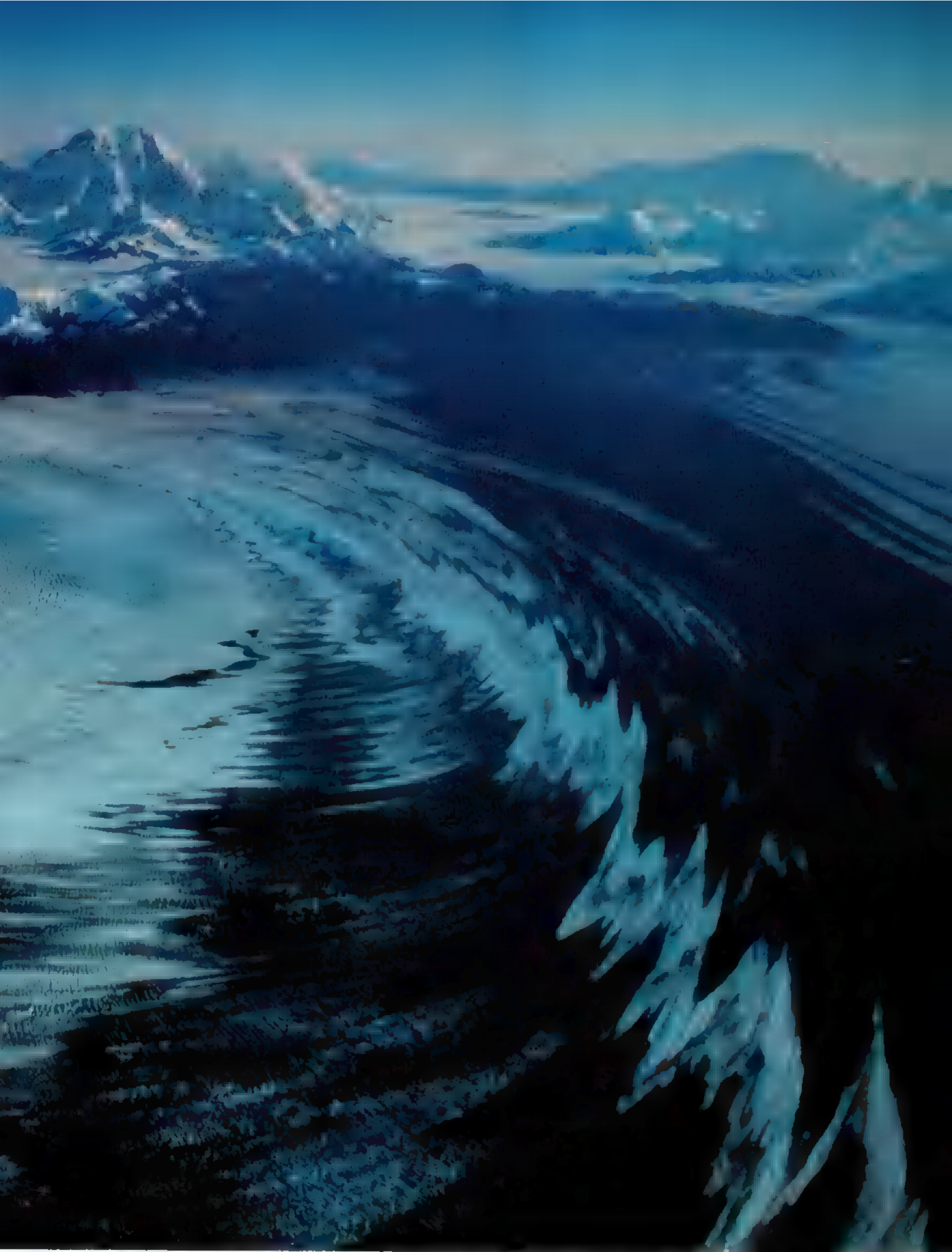
Wrangell-St. Elias National Park and Preserve covers more ground than Connecticut, Rhode Island, and Massachusetts combined.



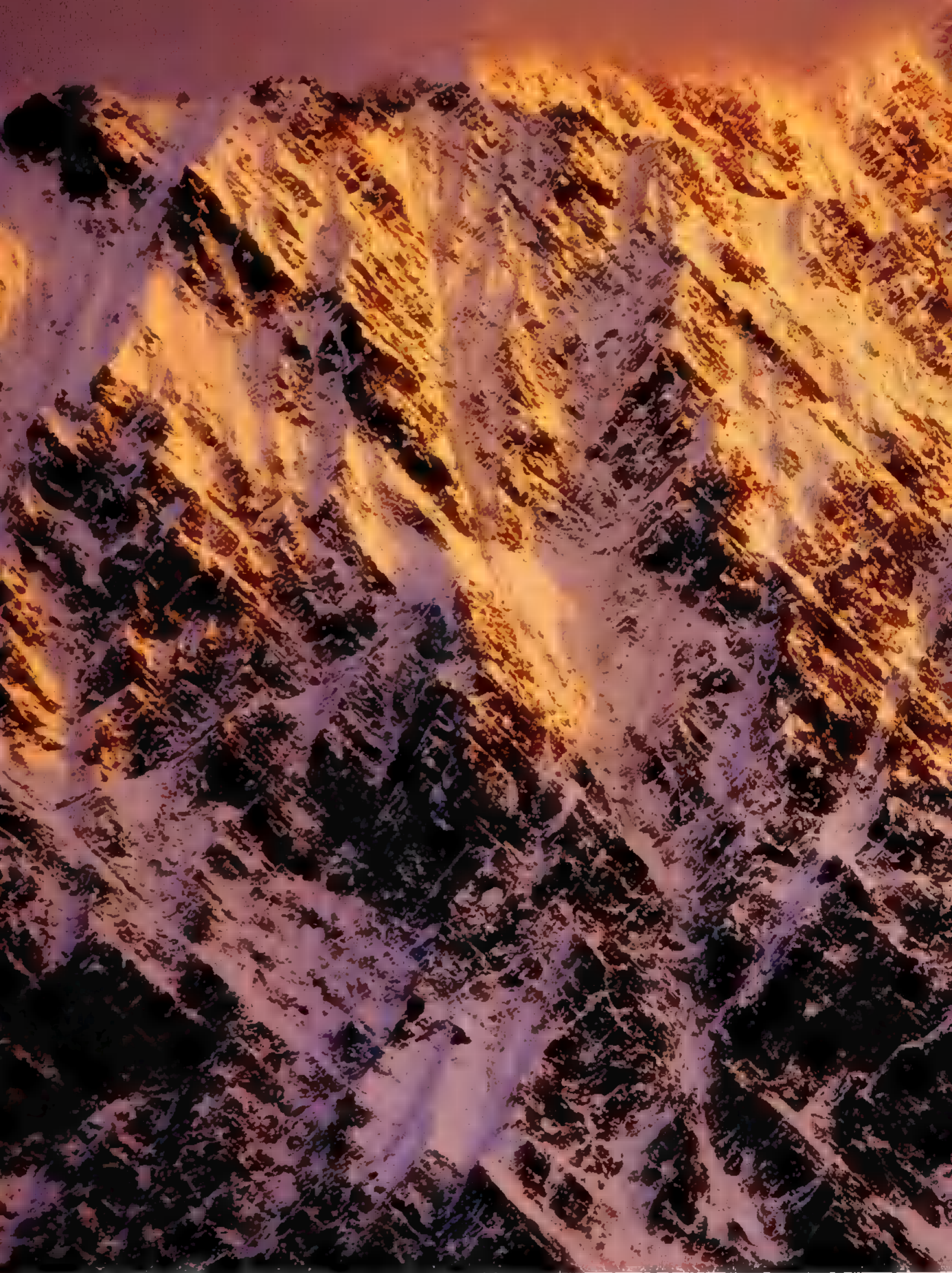


BEYOND SIGHT

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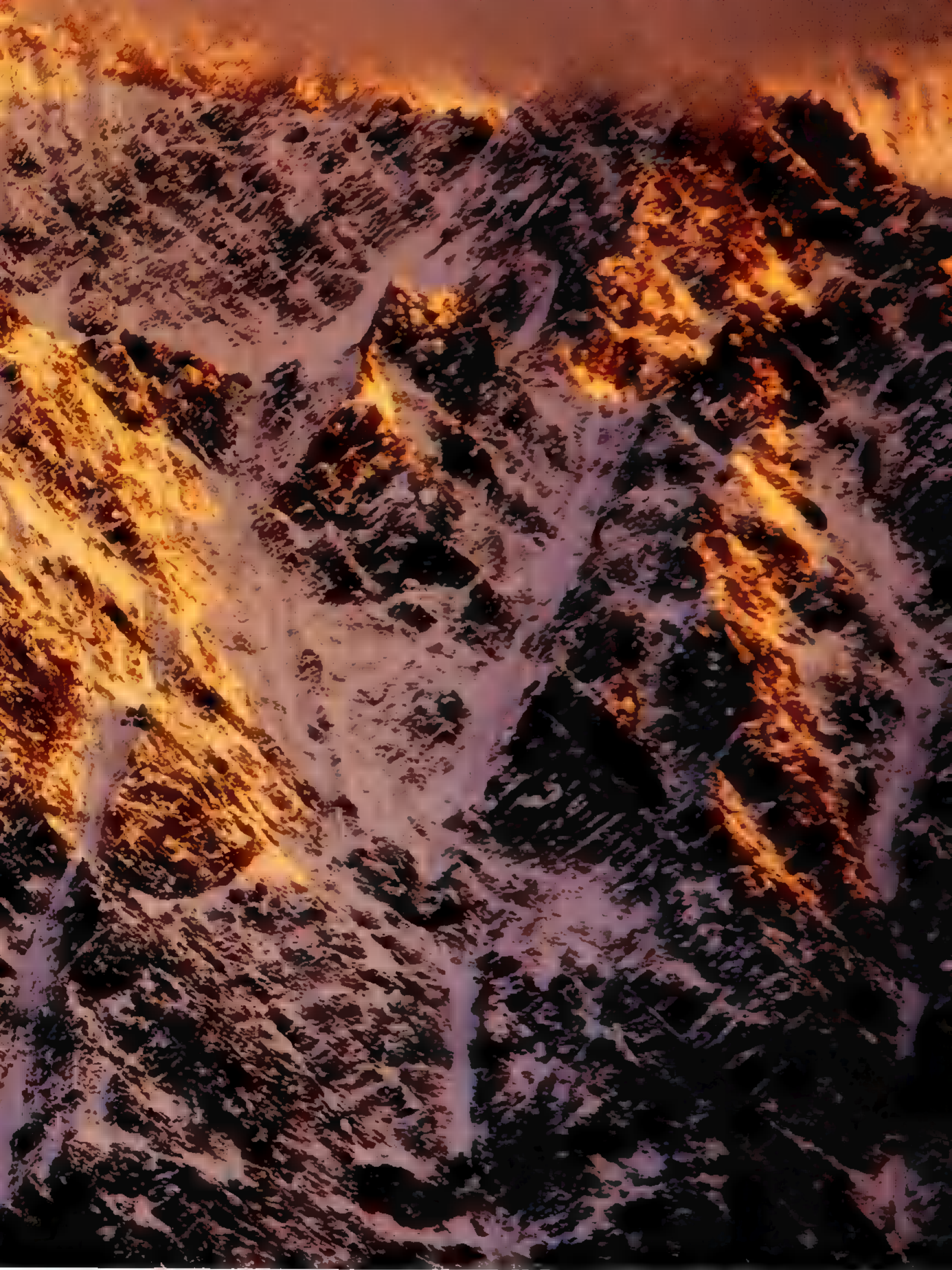


*Their sinuous ripples patterned by rocky debris, glaciers more than a thousand feet thick drape hundreds of square miles from the St. Elias Mountains to the sea. From an airplane at 16,000 feet, only a fraction of this prodigious ice complex (above) is visible.*



WALLS OF FLAME

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*The sun drops in the sky. First one then another mountain face kindles until the whole mass of the University Range seems to burn in scarlet and gold. From far below, lavender twilight moves up the jagged slopes, extinguishing the last fires of day.*

Wrangell-St. Elias National Park and Preserve.

In 1906 Kennecott Mines Company staked its claim near the Chitina River, a tributary of the Copper River, and soon a 196-mile railroad was a-building to haul the ore out to the coastal port of Cordova. By the time the lode was exhausted and the operation shut down in 1938, Kennecott had mined more than 4.5 million tons of ore valued at some 200 million dollars. Alas, the miners were not as proper at names-making as the explorers had been. The copper company was supposed to have taken its identity from the Kennicott Glacier, which in turn had been named after Robert Kennicott, an early wayfarer in the Great Land. The company never got around to replacing the errant *e* with the proper *i*.

In any event, long before names favoring the memory of some plush patrician, forgotten saint, or frostbitten scout began filling the blanks on the map, the oral tradition of the indigenous Native American peoples had already identified some of the same physical features. Thus while the Athapaskan Ahtna people called an active volcano K'elt'aeni, meaning in rough translation, "The One That Controls" the weather, newcomers graciously named it for Baron Ferdinand Petrovich von Wrangel, an early governor of Russia's Alaska territory, handing the baron an extra *l* in the process.

So vast and seemingly uninhabitable is this landscape, I find it astonishing to imagine it rimmed with traces of aboriginal habitation, some dating back almost to a time when Alaska was just getting out from under nothing but ice. But the Park Service reports the presence of scores of archaeological sites and ancient hunting camps used by the paleolithic predecessors of such cultural groups as the Athapaskans (on the north and west of the park), the Eyak Indians (near the Copper River Delta), and the Tlingit (at Yakutat Bay and along the Malaspina forelands). Today upward of 4,000 people, both Anglo-Alaskan and Native American, live in the little hamlets of the Copper Basin around the park, or on the million acres of private lands within it. For many of them, Wrangell-St. Elias is more than a place of rock and ice.

With Dall sheep among the crags and moose in the sloughs of the wooded lowlands, the park continues to serve the traditional subsistence needs of the local people.

**SOME OUTSIDERS**—"outside" being the Alaskan's term for the lower 48—have a problem with the idea of hunting in the national parks of the Great Land. Outside, hunting isn't permitted in park system units listed officially as national parks, so how come it's permitted here? Well, the realities of rural Alaska are how come. When President Jimmy Carter signed the Alaska National Interest Lands Conservation Act in 1980, establishing Wrangell-St. Elias National Park and Preserve and bringing a half dozen other big wild areas into the Park System, a policy embedded in the legislation recognized rural Alaska's long-standing reliance on fish and wildlife. The policy allows local rural residents to hunt for subsistence in the areas set aside as national park. But nonresidents and sport hunters, from, let's say, Fairbanks and Anchorage, may hunt only in the areas designated national preserve. (About two-thirds of Wrangell-St. Elias is park; the rest, preserve.) What's more, while motors are prohibited in wilderness areas in the lower 48, the rule book here allows for traditional forms of transportation. In backcountry Alaska, that means snow machines and fixed-wing aircraft.

The Glennallen charter pilot Lynn Ellis, for example, flies a regular mail and air service into McCarthy, near the Kennecott mill site, and often ferries hunters and backpackers up to Nabesna, where his two brothers run a guiding business. Each community lies at the dead end of a gravel road—the only two roads inside the park. The washboarded one that leads 60 miles from pavement to McCarthy claims bragging rights as the worst road in Alaska. "Be prepared for flat tires," the brochures warn. No wonder many folks would rather take to the air.

Drake Olson does his flying in Wrangell-St. Elias's southeast corner. We got into a little airplane, and Olson pointed its nose toward

**WEBSITE EXCLUSIVE**

Online extras: Planning a trip to the largest U.S. national park? Get travel tips here and find a photo gallery of more images at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).



GLEAMING IN A WREATH of ice and clouds, the 14,000-foot peak of Mount Wrangell greeted photographer Frans Lanting with an “incongruous sight,” he recalls: “steam pouring across a snowfield.” The boiling vapors are driven by heat rising from deep within the Earth. Wrangell is still an active volcano—though its last lava flow occurred more than a thousand years ago.

Disenchantment Bay and the Hubbard Glacier.

For a big sliver of ice in the age of global climate change, the Hubbard had been acting strangely. Scientists report that most of Alaska’s glaciers are slowly receding. Yet here was the Hubbard going the other way; not only that, but advancing so far into Disenchantment Bay as to close off the mouth of Russell Fjord, thereby turning the fjord into a lake.

“Well, look at *that*,” Olson said as we banked over the headland of Gilbert Point. Just a month or so earlier he had seen the Hubbard’s terminal moraine jammed tight against the gray nose of

the point. Now, the dam formed by the moraine had been washed away, and 400 feet of open water separated the ice from the point. “Lake Russell’s a fjord again,” Olson said.

Onward to the Malaspina. This one is reported to be shrinking, but you’d never know it. From 2,000 feet it looked to me like a giant saucer of vanilla ice cream with bands of chocolate-fudge ripple—the scoured grit of mountainsides—meandering through. To the north, between the rim of the saucer and the scrim of the clouds, we could see the lower slopes of the St. Elias range on the Yukon border—Mount Cook, Mount Augusta beyond the Malaspina-feeding Seward Glacier, and, straight on, the Samovar Hills shrouding the knees of St. Elias itself.

Then the clouds started tumbling down, so we turned around and headed for the coastal village of Yakutat. That’s the way it has to be, sometimes, in big, lonely country. When you can’t see the top of the mountain, then you’ve got a problem if you can’t be content just knowing it’s there.



AS TALL AS THE SKY

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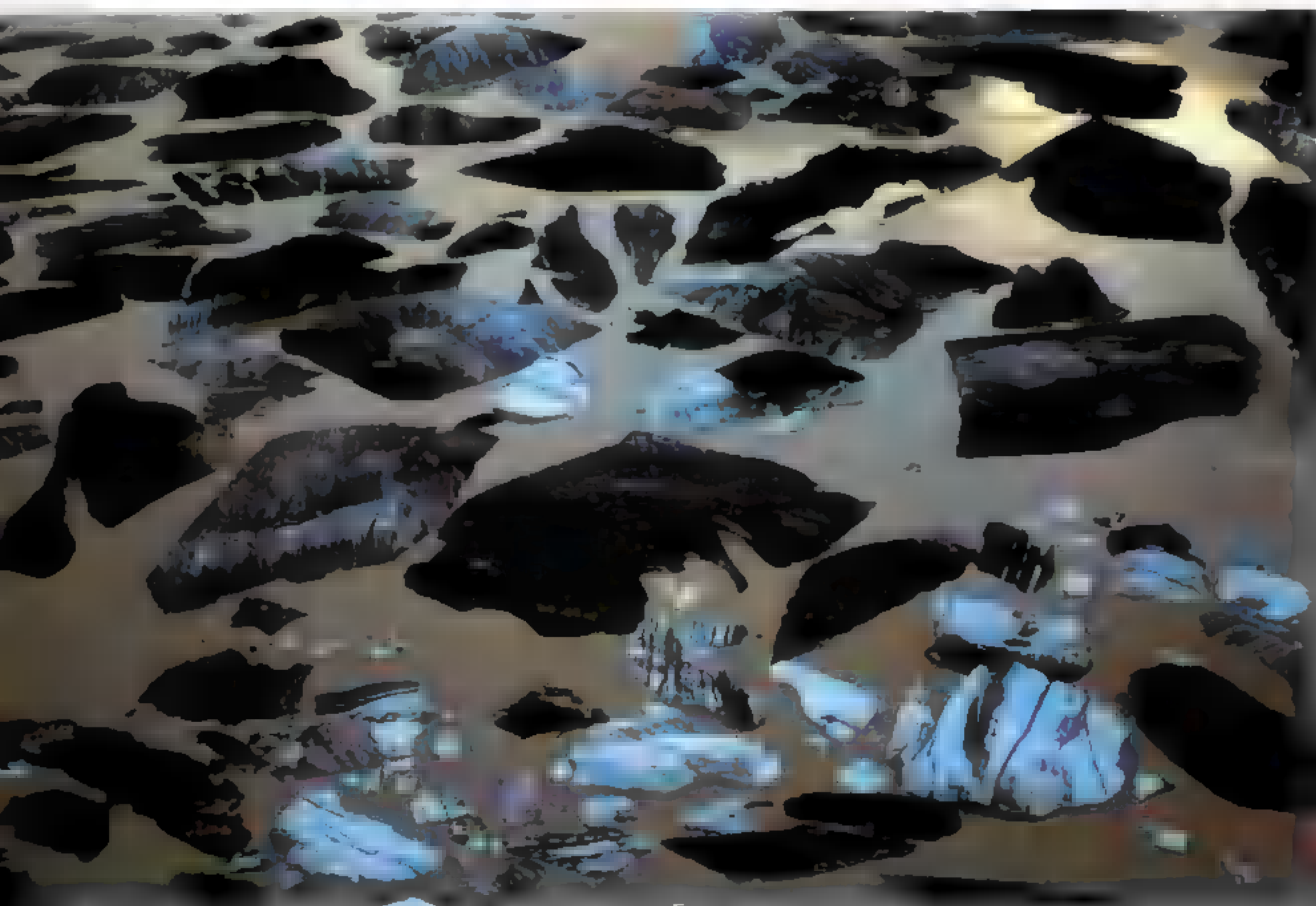


*The mountains above Nabesna Glacier rise in cloud-shadowed ranks, decorated with brilliant swirls of weathered mineral deposits like marbled endpapers in an antique book. Many peaks in Wrangell-St. Elias remain unnamed—and unclimbed—more than 20 years after the park was established.*

## A QUESTION OF SCALE

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*They look like stepping-stones in a backyard pond. But the sediment-darkened icebergs clogging the lake at the foot of Nizina Glacier (below) are each some 300 feet across. Kennicott Glacier meltwater (right) cuts a canyon in dust-streaked ice that meanders the length of a football field. "There are no familiar objects in sight with which to make eye-measurements," Israel Russell said of Alaska in 1890. "The picture is on so grand a scale that it defies imagination's grasp."*







FORCE OF NATURE

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*With 75 miles of ice bearing down behind it, Hubbard Glacier's leading edge, foreground, forms a 20-story wall brooding over Disenchantment Bay. In recent decades the glacier has twice blocked the mouth of Russell Fiord, at left, temporarily transforming it into a 70-square-mile lake.*



A M O M E N T A R Y E D E N

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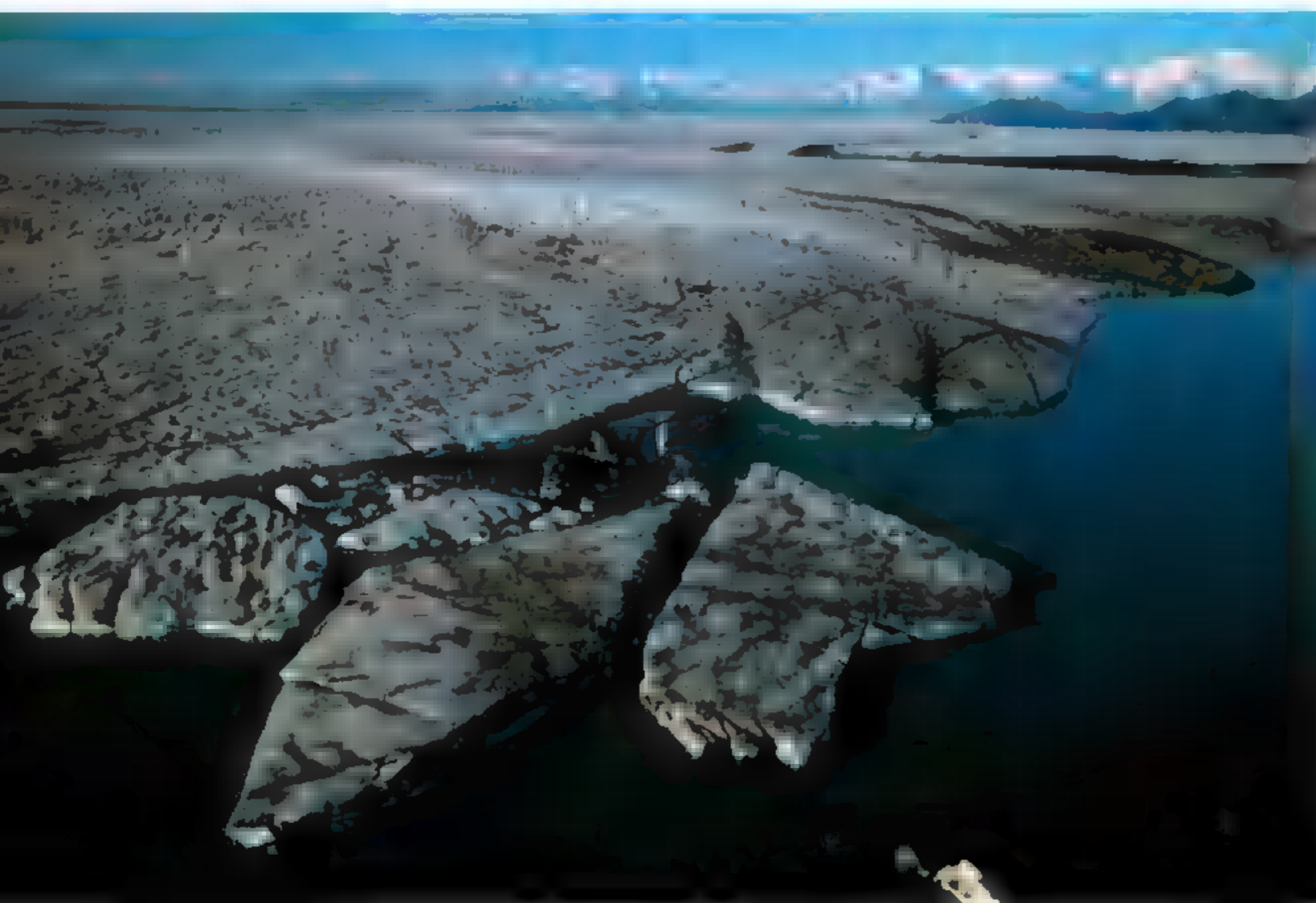


*Its brushes soaked in bearberry crimson, aspen gold, and the bristling blue of spruce trees, autumn paints tumbling slopes with the vivid genius of a Monet or a van Gogh. The exhibition lasts only days—a final flourish before the long monochrome of winter.*

## A BESTIARY OF ICE

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*Like a wrinkled, leathery hide stretching from the Chugach Mountains (below) to the Gulf of Alaska, Bering Glacier drains ice from within the park's boundaries, then flows some 50 miles onward to its breaking points in Vitus Lake. Far inland a rock glacier shoves muddy paws down the steep, thickly forested slope of Sourdough Peak (right). A dense matrix of stones bound together by ice, a rock glacier often resembles a bed of lava.*










PERFECT CALM

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*Last light glows on the horizon. Stillness settles across Chitina Valley's broad spruce-covered floor, where ponds mirror the blue and white of a delftware sky. □*

A man wearing a white thobe and ghutra is driving a BMW convertible in a desert landscape. The car is a dark color, and the man is wearing sunglasses. The background shows a vast, flat desert under a clear blue sky.

From the seat of his BMW, Sheikh Saud, head of Qatar's council for culture, surveys his holdings.


revolution  
from

Soon to be the world's richest nation, fin

A man in a white thobe and ghutra is driving a car in a desert at night. The car's headlights are on, illuminating the road ahead. The man's hands are on the steering wheel. The background shows a dark desert landscape under a clear night sky.

# the top down

**QATAR**—a key U.S. ally in the Persian Gulf—steers toward the modern world



Colossal dunes undulate toward the Umm Said industrial port, where a gas flare proclaims Qatar's vast petroleum wealth. Revenues from oil and the world's second largest deposits of gas, after Russia's, are controlled by Sheikh Hamad bin Khalifa al Thani. He seized power from his father in 1995 and began to modernize Qatar—a social restructuring still being sorted out.








BY MARY ANNE WEAVER

PHOTOGRAPHS BY ROBB KENDRICK



THE STORY OF MODERN QATAR began the old-fashioned way: When a son dethroned his father. It happened near the end of June in 1995, as dawn broke over the splendid teak and marble royal palace in the seaside capital of Doha. The aging emir, Sheikh Khalifa bin Hamad al-Thani, was en route to a holiday in Switzerland, leaving his firstborn son, Hamad, 45, to run the country in his absence. By 5:30 a.m., Sheikh Hamad, who had been up all night, stood before an assembly of royal courtiers and representatives of Qatar's most influential families and major tribes and announced that he was taking over. No one protested or even evinced surprise, for in keeping with Bedouin tradition, Hamad had consulted them in advance. All that remained was for them to swear allegiance, and so the dignitaries—a hundred men in flowing white thobes and brown robes trimmed in gold—came forward to kiss him, depending on their kinship, on the head or shoulder or cheeks of those

Weeks earlier, a council of the ruling al-Thani family had agreed with Sheikh Hamad that his father, who had developed an unseemly fondness for opulence and alcohol, was unfit to continue at the helm of Qatar's hereditary monarchy. This consensus enabled Hamad, who was crown prince, to legitimately assume power that morning in

A woman's black *abaya* deflects glances and reflects tradition. Yet like women in more liberal Islamic states, Qatari women can vote and hold office, rights granted by edict in 1997.

June. So by the time the sun was full over the palace, Sheikh Khalifa's 23-year reign had come to an end.

Shortly thereafter, the new emir—his father's fair-haired boy, the first of his five sons—telephoned his father in Switzerland to break the news. Forewarned, an outraged Khalifa refused to take the call.

That wasn't the end of it. Eight months later Sheikh Khalifa, backed by many of his fellow monarchs in the Persian Gulf, attempted to regain his throne by launching a counter coup, an undertaking doomed from the start.

Six hundred Bedouin tribesmen, recruited by Khalifa loyalists, crossed into Qatar from Saudi Arabia, but once across the border many became lost. Meanwhile a band of French mercenaries, hired as a "seaborne invasion force," left their five-star hotel in Doha and went to the beach,

but they couldn't find their boats. And there were stories like this, from a man who had been sitting in his garden when he heard a rumble "rather like a tank." He tiptoed to the garden's edge and looked out beyond the gate. To his astonishment he saw a Land Rover filled with half a dozen large Bedouin men, their red-and-white-checked kaffiyehs dancing in the wind. "They were arguing among themselves," he told me, "and they were clearly lost. How is it possible to get lost in Doha?" he shook his head. "One of them was shouting 'Where's the palace?' into his mobile phone."

When the coup d'état failed, Sheikh Hamad arrested more than a hundred conspirators and demanded that his father—who lives in the south of France when he's not in London—return several billion dollars to the state. (He returned around a billion dollars in 1997.) As



important, in a region where egos are elaborate and the rituals of power baroque, Sheikh Hamad began to reign in a manner that his fellow monarchs—whose average age was 68—considered heretical, by declaring a series of political and social reforms that in a few short years have transformed this tiny sheikhdom into a vastly different Qatar than the one his father had ruled.

**ONE OF THE SMALLEST** and least known countries in the Arab world, Qatar is, after Saudi Arabia, the most conservative and most traditional society in the Persian Gulf, where Wahhabism, a strict interpretation of Islam, is the official religion and falconry and camel racing are national pastimes. Rich in oil and natural gas, Qatar (pronounced KUT-ter) is one of the wealthiest nations on Earth. It is also, under its relatively young



## Power Player

**Qatar juts from Arabia as if boldly proclaiming wealth and clout far beyond its size—only 50 miles wide and 100 miles north to south. State revenues of 16.5 billion dollars a year are funding Qatar's transformation from backwater to regional power. In the capital of Doha, a reclaimed island anchors a new private resort encircled by sites for walled estates (left). Construction is also brisk at Al Udeid, a Qatar air base (below), where U.S. military planes line up within striking distance of Iraq. A staging area for the 1991 gulf war, Qatar now lies at the center of the geopolitical storm that is the Middle East.**

SATELLITE IMAGE BY GLOBAL SECURITY AND DIGITAL GLOBE





**Incongruities abound along Doha Bay, where the hot pink flash of a Barbie beach ball provides a prop for a Jordanian computer analyst relaxing with his family. Such foreign guest workers make up two-thirds of Qatar's 600,000 people.**

emir, the Arab world's most revolutionary.

Sheikh Hamad's Qatar is a place where women have been given the vote, and where a population raised on tribal monarchy was recently urged—by its monarch—to get out and vote. It is home to two U.S. college campuses, including a medical school imported from Cornell University, giving Qatari students unprecedented access to modern ideas and opportunities. It has also mounted the world stage: as a key staging area for U.S. military forces in the

gulf and as the home of Al Jazeera, the Arab world's answer to CNN.

Such changes might be expected to resonate with the young. Yet it's the younger generation that appears to be most unsettled by the reforms of Sheikh

Hamad. Young men, feisty and politically aware—and educated largely in the West—are heavily influenced by the broader currents in the Muslim world, including the Islamic activism they encounter in local mosques. And young Qatari women are, it turns out, even more conservative than young men.

No one had been pounding on the palace gates, beseeching the emir to reform his country, share political power, or grant women political rights. The reforms had been his idea.



All of which poses the question: Can a tradition-bound Arab country, even one as small and fabulously wealthy as Qatar, be reformed by royal decree, from the top down?

I arrived in Doha after an absence of 18 months; much had changed since my previous visit, which came before the tragedies of September 11. In late 2000 Qatar had assumed leadership of the influential Organization of the Islamic Conference, and in November 2001 it had successfully hosted the leaders of the World Trade Organization. It had also experienced its first terrorist attack, when a gunman opened fire on U.S. troops at a Qatari air base; he was killed in the exchange.

Qatar seemed considerably richer than on my last visit, and I soon discovered why. Its

economy—arguably the fastest growing in the world—was being lifted by revenues from natural gas. As a result, Sheikh Hamad's subjects, whose per capita income is estimated to be more than \$28,000 a year, are now among the richest in the world. And wealth had brought its own kind of revolution.

At night the sparkling lights of Doha, which had always resembled a necklace of pearls, were now studded with neon baubles from McDonald's and Kentucky Fried Chicken. For morning coffee I had a choice of Starbucks (where a crowd of young men told me how wonderful Osama bin Laden was) or a coffeehouse in the suq (where a crowd of old men told me how wonderful Saddam Hussein was).

Both men and women are increasingly flocking abroad to Western, including American, universities. On their return to the sheikhdom, many become part of the growing number of young technocrats who serve in the government. Others take over professional and managerial posts. Everyone is encouraged to take up jogging, tennis, or golf—the influence of Sheikh Khalifa, who, as other Persian Gulf sheikhs were transforming their nations into mercantile centers and financial hubs, was riding around Doha in a black Mercedes, inspecting the construction of museums and sports clubs. So today young women, shrouded from head to toe in black *abayas*, can be seen jogging along Doha Bay in bright new running shoes.

Qatari society is so small that everyone seems to know everyone else—with the possible exception of the guest workers. Of the sheikhdom's total population of 600,000, less than 200,000 are citizens of Qatar. The other 400,000 are foreigners, who tend to live in their own compounds and keep to themselves. Qatar's oil and gas industries are run in part by Americans, Canadians, Britons, and French; its government offices are frequently staffed with Palestinians, Syrians, and Egyptians; its taxicabs and restaurants, with Filipinos, Indians, and Pakistanis.

**TAKE TO AN AIRPLANE** and Qatar recedes to a tan flatness, but on the ground its deserts become undulant mountains of sand rolling down to the sea. Geographically, the country is a peninsula the size of Jamaica: 4,400 square miles of land protruding from Saudi Arabia into the Persian Gulf.



Not so long ago, the borders of Arabia were imaginary lines in the sand laid down by warring tribes, and it was into what is now Qatar that Sheikh Hamad's al-Thani ancestors migrated from the vast central desert of Arabia in the mid-1700s. Had the al-Thanis not come under British protection in 1868, and signed an agreement with Britain in 1916 that allowed for Qatar's eventual independence in 1971, the sheikhdom could easily have become a province of Saudi Arabia.

The peninsula had few apparent resources except for pearls, and by the mid-18th century it was one of the most productive pearling grounds on Earth. Oil was discovered in 1939, and it is still being discovered today. Off Qatar's northeast coast lies the world's largest deposit of natural gas not occurring with an oil field.

The size of that deposit is difficult to grasp: It covers an area half the size of Qatar itself and holds some 900 trillion cubic feet of natural gas, enough to heat all U.S. homes for more than a century. Being developed at an accelerated rate, this field promises to make Qatar one of the world's largest suppliers of energy, and in a few years the richest nation, per capita, on Earth.

Under Sheikh Khalifa, who ascended to the throne in 1972, as oil revenues started to pour in, Qatar became a welfare state whose citizens were provided all amenities. It also began to stagnate under his tepid and insular leadership.

Hamad, Khalifa's eldest son, was born in Doha in 1950, the only child of Khalifa's favorite wife, who died shortly after Hamad's birth. He was raised to his father's specifications and educated in Doha, where he studied the Koran and sharia law. When he was 17 he went to study abroad in England, where he fine-tuned his ear for politics. (As a teenager, he'd even been briefly detained, in Doha, when he and a group of school chums demonstrated in support of Arab nationalists.) After his father ascended to the throne, Hamad, by then back in Qatar, became commander in chief of the nation's armed forces and was named as his father's heir.

A subtle contest for power between the increasingly distracted Khalifa and his increasingly independent son surfaced during the 1991 Persian Gulf war, when several thousand U.S. troops were sped to the sheikhdom, which they used as a staging base for air strikes against Iraq. After the war Sheikh Hamad, who had argued



**A month after 9/11, Yasser Arafat and Sheikh Hamad conferred at a summit in Doha. Hamad bankrolled Al Jazeera (above), the 24-hour news network that ran Osama bin Laden's exhortations after the U.S. bombed Afghanistan. The network presents an Arab perspective on the news yet airs divergent views, rare in a region where the media traditionally toes the government line.**

Some are assigned to Camp Snoopy, a high-security facility on the outskirts of Doha; others are at As Sayliyah, on an enormous, Pentagon-financed pre-positioning base in the eastern desert, the largest such facility outside the United

States. Still others are at Al Udeid, a Qatari air base deep in the desert that Sheikh Hamad built at a cost of more than a billion dollars. He recently went one step further, authorizing the United States Central Command to stage a major military exercise, held in December 2002, out of As Sayliyah.

Months after 9/11, I asked Muhammad al-Musfir, a professor of political science at the University of Qatar, how the U.S. presence was playing here. Not well, he told me.

"Your military is a very provocative element, and it's not just my students who are saying this," he said. "Go to the suq. Go downtown. Go to any café. The attitude is decidedly anti-American." He also took issue with the idea, promoted by the government, that Qatar's military alliance with the U.S. was making it more secure. "Qatar has no enemies; it faces no threat. In the long term, the American presence will not serve our security. Sheikh Hamad's reforms, in the end, are the greatest security blanket that he has."

for opening Qatar to foreign investment, began, as defense minister, to forge a military alliance with the United States. As emir he followed through, and today Washington has an enormous stake in Qatar.

I met with Sheikh Hamad in 2000 at the royal palace in Doha. He was dressed in a traditional white *dishdasha*, his face was framed by a flowing white kaffiyeh secured by a black cord, and he wore wire-rimmed spectacles perched on his nose. Unlike other Middle Eastern monarchs I've met, Sheikh Hamad's manner was informal, at times ebullient, and he spoke in impeccable English polished at Sandhurst and Cambridge.

I asked the emir if he would ever permit U.S. troops to be based on Qatari soil. Given the problems that a U.S. military presence has caused Saudi Arabia, I was taken aback by his reply.

"If the United States asks, there will be no opposition," he responded without pause.

After 9/11, the Bush Administration came calling. Today more than 3,300 U.S. military personnel, largely from the Air Force, are based here.



**Oiling the wheels of daily life, Pakistanis tend to handle the heavy lifting, Filipinos mind the homes, and a surplus of resident aliens chase low-end jobs. Grouses one immigrant, "Qataris treat us like they can throw us away."**

One Friday morning, just before midday prayers, I went to the falcon market with a friend. January is the falconing season, and the birds were selling swiftly, and for a substantial price: A blond shaheen from Iran had fetched the equivalent of \$30,000, a dealer named Hussein told us with a broad smile. We then settled ourselves in overstuffed armchairs, arranged in a large circle in his shop, and sipped Bedouin coffee from tiny porcelain cups.

A family of falconers joined us: a father and

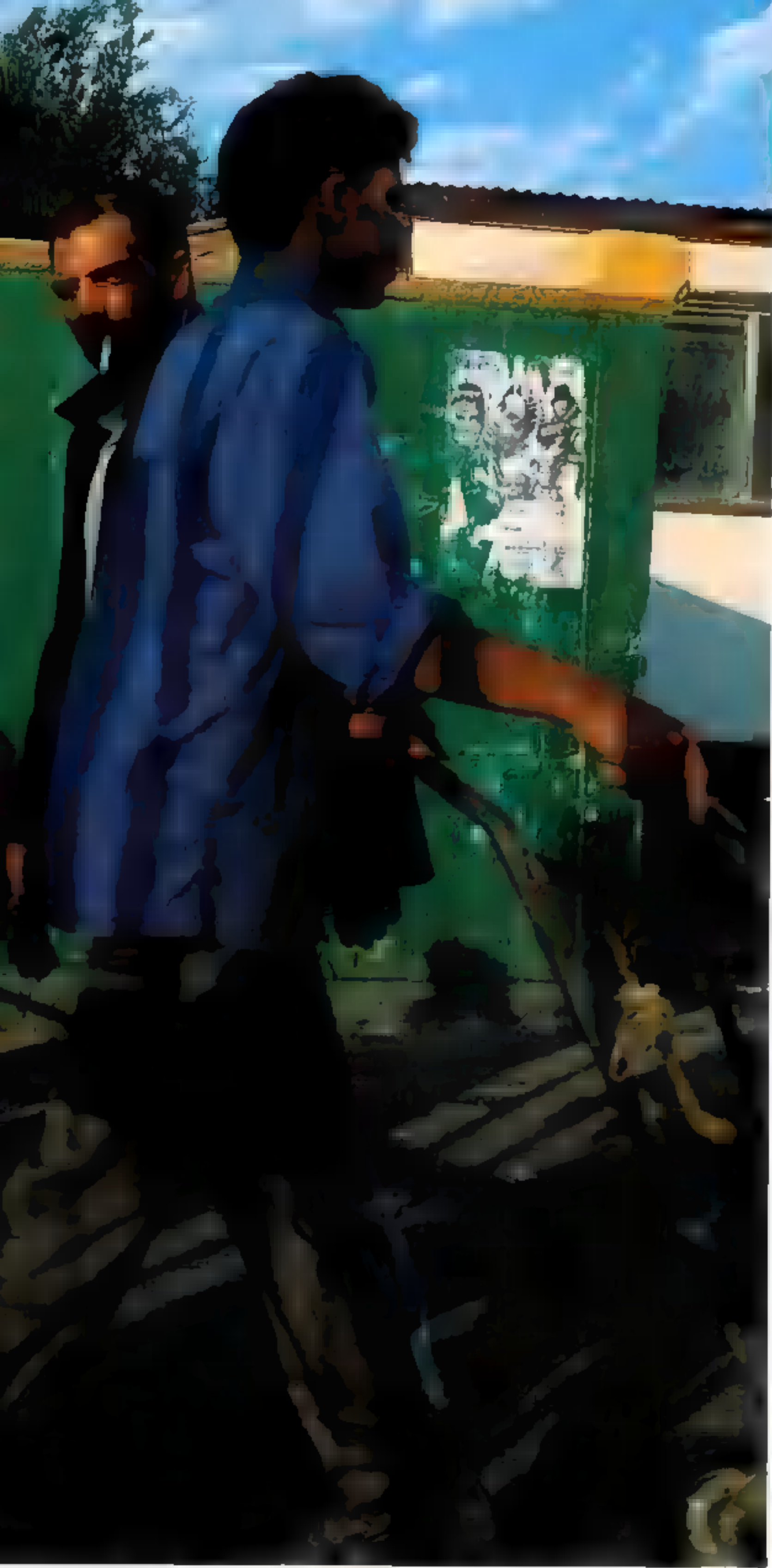
his son, and a bright little boy of six, who was the older man's grandson. Normally at this time of year scores of Qataris would be off to Pakistan with their falcons to hunt the houbara bustard, a cursorial desert bird that

migrates there each autumn—via Afghanistan—from the Central Asian steppes. But the birds were late this year, and the falconers were most distressed.

"It's your government's fault," the son said to me. "Your bombing campaign in Afghanistan has disoriented them!"

I attempted to lead the conversation around to the emir's reforms, but the falconers were intent, like nearly everyone I met, on criticizing the United States and its war on terrorism,





often referred to here as a war on Islam.

Although religion touches nearly every aspect of Qatari life, Islam here is a coastal breeze compared with the angry winds swirling over other parts of the Middle East. It's true that Qatar is the world's only Wahhabi state other than Saudi Arabia, adhering to the strict interpretation of Islam put forward by Muhammad Ibn Abd al-Wahhab, a religious leader in central Arabia who formed an alliance with the House of Saud in 1744. Yet Qatar has always worn the cloak of Islam far more loosely than Saudi Arabia. There are no militant Islamist groups here, no radical clerics calling for jihad during Friday prayers.

Still, there is religious activism. Some Qataris have joined scattered missionary groups known

as Da'wa that are proselytizing and actively recruiting, especially among the young, in their advocacy of a more rigid form of Islam. Qatar's so-called Da'waists wear the long, broad beards and white calf-length robes that are emblems of devout Wahhabi faith in Saudi Arabia. Other Qataris make up what are by far the largest and most amorphous of the groups, known collectively as "the traditionalists." Most of them are considered, at least for now, harmless dissenters who cling to the status quo and oppose the emir's reforms.

Still other Qataris are admirers of Osama bin Laden, who is rumored to have occasionally visited a villa on Doha's beach until he went underground in Afghanistan in 1999. That villa is owned by an Islamist financier who is also a member of the ruling family. U.S. investigators are trying to establish whether he had any links to a handful of Qataris—the number is in dispute—who were captured by American forces as they fought in Afghanistan with the Taliban.

**ON MY VISITS** here in recent years, I'd come to appreciate the fine art of the Qatari picnic, which involves slipping out of Doha in a four-wheel drive loaded with bottled water and picnic supplies, and heading down the coast to Khor al-Udeid, a beautiful, secluded beach at Qatar's southernmost tip. So one morning I set out with two friends, Moza al-Malki and Zakia Malallah, who had become my eyes and ears as they led me by the hand through various passages—close-knit families, nascent empowerment groups, and contradictions and confusions—of Qatari women attempting to find their way in the modern world.

Between them they probably shared as many firsts as any two Qatari women: Moza, 44, was the first Qatari woman to have earned a master's degree in psychology and worked as the sheikhdom's first practicing psychotherapist. She now holds a Ph.D. Zakia, 42, who studied in Egypt, earned her country's first Ph.D. in pharmacology and now runs a government pharmaceutical lab in the capital. Moza had been a candidate in municipal elections in 1999—the first elections in Qatar's history—and had been the nation's first woman to drive. Zakia was one of the first female Qatari poets to be published outside the country.

As our driver navigated the outskirts of Doha,



Uneasy rider: A child jockey strapped to his mount with Velcro howls in distress just before a sprint. South Asian parents receive money for sending their sons—some as young as three—to Arab countries such as Qatar, where camel racing is an extremely popular sport. Human-rights groups deplore the practice, charging that the children are exploited.





I watched as they served breakfast in the car on colorful paper plates. The scene was a bit incongruous: Moza, dressed in blue jeans and a beret, served a variety of traditional beans laced with marinades. Zakia, who had removed her face mask but not her abaya and veil, passed around bags of Fritos and potato chips.

About an hour south of Doha we left the highway. Between us and our destination there was no road, only desert, and we set off in a cloud of dust. Then, suddenly, the sand dunes began, looming on both sides of our car: A vast maze of peaks and dips, undulating ergs, they looked to me like monumental anthills. Some of them rose to a height of 30 feet and, as we raced up them, then hurtled down, it was like riding a giant roller coaster, or perhaps worse. Molded by the wind, the dunes constantly changed shape and form as they enveloped us in their expanse of beige and ivory, orange and red. At times they seemed to move and shift around us flirtatiously; at other times they seemed to chant.

After 45 minutes of this, we reached Khor al-Udeid, a picture-postcard beach, populated mainly by flamingos, where Qatar comes to a

sudden but memorable end. In the distance, we could see a scattering of brightly colored *shamiana* tents and clusters, here and there, of bamboo tables and chairs. On the horizon, just beyond the dunes, stood the pink cliffs of Saudi Arabia.

We unpacked our towels and bags, then joined a few dozen other picnickers on the beach. While Moza and I sat watching the waves, Zakia, her abaya blowing in the wind, moved off down the shore.

I asked Moza to tell me about the municipal elections, in which she had been one of six female candidates. At the time, I remembered, a religious conservative had petitioned Sheikh Hamad to prevent women from running. He ignored the admonition, and the elections went ahead according to plan: the first poll in any gulf state in which women both voted and ran. During her campaign, Moza sent a questionnaire to her constituents asking, "Have you ever heard of democracy?" Fifty percent responded no. And on election day, she and the other women were defeated at the polls.

I asked why. "Because women didn't vote for us," she replied, explaining that 80 percent



**Saddam Hussein and George W. Bush face off on paper as women follow the news while selling carpets (left). Students follow the fashions at a design class in Doha run by Sandra Wilkins of Virginia Commonwealth University (above). "Under their abayas," she says, "Qatari women wear some of the most stunning, stylish outfits in the world—easily matching the Europeans."**

"We weren't happy," said one of his older friends. "We were tranquilized."

**A WAKE-UP CALL** went out to Qatar, and the Arab world, when Sheikh Hamad launched Al Jazeera in 1996

of her votes came from men. One of the female candidates, Moza went on, had received only 15 votes from women. The woman had voted for herself and the 12 female members of her family had supported her. Today, nearly four years later, she continues to puzzle over who the two other women were.

Zakia now returned, leading a group of six or seven men toward us across the sand. They were friends of hers from the government. As we chatted, American planes flew in formation overhead. Everyone in our newly enlarged group was full of opinions on everything, from Washington's growing military presence here to the pace of Sheikh Hamad's reforms, which are supported mainly by intellectuals and academics, along with influential members of the ruling family.

"Why are we spending 30 million dollars a year on Al Jazeera?" one young man asked excitedly. "We are meddling in everyone's affairs and making ourselves a sitting duck. We were quite happy as we were before."

with a pledge of 140 million dollars. At about the same time, he dismantled Qatar's Ministry of Information, abolished censorship, and gave his new television network license to follow its journalistic mission.

Today opposition leaders from across the Middle East flock to its studios to challenge their governments; other guests have included, via videotape, Osama bin Laden and other leaders of al Qaeda. Subjects like torture and tyranny are hotly debated. Panelists confront each other, and viewers call in with questions or opinions of their own. Al Jazeera has transformed journalism in the Middle East, made Qatar a force to be reckoned with in regional and world affairs, and shaken the status quo.

The emir did not start Al Jazeera to irritate his fellow rulers, insisted his minister of foreign affairs, Sheikh Hamad bin Jassem bin Jabr al-Thani. Nevertheless, both men seemed to take a wicked delight in the bedlam the station has caused, particularly when the noise disturbs the sleep of the giant next door, Saudi Arabia.

In the imposing sanctuary of home, nine-year-old Israa al-Marzouqi toys with an abaya, which she'll wear in public upon reaching puberty. "I wish for more opportunities for her," says her mother, Maryam, who follows Qatari tradition by remaining largely cloistered at home.







**Linked by youth and faith, kids visit relatives for treats on the feast days ending hajj, the time for pilgrimage to Mecca. Their generation may inherit a Qatar both Muslim and modern, democratic and devout—if today's reforms endure.**

One of Al Jazeera's most provocative voices is that of Faisal al-Kasim, a 41-year-old Syrian who hosts *The Opposite Direction*, a popular show modeled after CNN's *Crossfire*. I asked him what topics had generated his most important programs. "Those that have touched upon the debate in Islam over highly sensitive religious issues," he replied. "I've had secularists challenge Islamists, and Islamists challenge representatives of their states. This is at the very core of what's happening in the Middle East today."

These have also been among his most controversial shows, including one in which two women debated the merits of polygamy. One, a leftist member of the Jordanian Parliament, opined that a seventh-century practice, though sanctioned by the Prophet, was "total rubbish" now.

As Faisal looked on in disbelief, his other guest, an Egyptian Islamist and traditionalist, stormed off the show, shouting "Blasphemy!" as she made for the door.

I asked the emir about the repercussions of sending such programs into the homes of some 35 million viewers, in an Arab world unaccustomed to hearing the truth on its nightly news.

"Was there any turning back with Al Jazeera?" I began.





“What a headache,” he responded, chuckling. “It has caused me no end of problems, I must admit. But those same people who protested against it are following it too. For a headache, I use aspirin, and I can live with it.”

In a speech during his first visit to the U.S., in 1997, the emir recalled President John F. Kennedy’s famous words: “Those who make peaceful revolution impossible will make violent revolution inevitable.” Qatar, he told me, could no longer isolate itself. The only hope the country had for coping with rapid change was to reform. In 1999 Sheikh Hamad put his belief in democracy into action, naming 32 people to a commission charged with drafting a new constitution, one that would set the stage for an elected parliament. With the emir’s expected

approval of the draft, which was finished last July, Qataris could once again go to the polls, perhaps as early as the end of this year.

“He saw Qatar before we had wealth,” observed Sheikh Hamad bin Jassem, the foreign minister, of the emir. “We had no hospitals; some people had no medicine or food. So you can imagine when oil came: People here didn’t even know what money was. Not surprisingly, the money was misused. Even with all this wealth and all this luck, the emir saw Qatar going nowhere. In his view, Qatar wasn’t modern enough to survive.”

It may take years to reform such a tradition-bound society, but today Qatar is moving forward in new and unexpected ways. In fact, of all the changes I saw during my recent visit, one of the most radical is occurring in Doha’s City Center, a popular new shopping mall that is among the largest in the Persian Gulf. Socially, Qatar is still a largely segregated society, where most marriages are arranged, nearly half of them within the extended family. Even at the university, no classes are mixed; men and women have few opportunities to meet.

Yet now, at the City Center, riding the escalator has become a social event. Out one evening with some Qatari friends, I watched groups of young women dressed in flowing black abayas and veils, but with their faces uncovered, glide up an escalator as groups of young men passed by, riding down. Glances were exchanged, and so, on occasion, were coquettish smiles. Elsewhere men and women even sat together and talked, in the coffeehouses and restaurants sprinkling the mall, as their bored brothers, or nervous aunts or mothers, looked on.

“Before the mall, each family would sit together at home,” Sheikha al-Misnad, a vice president of the University of Qatar, had told me. “Now people are going out; they’re seeing other families, and they can relate to each other. Going to the mall, just walking, or sitting around is totally new in our society.” Qatar is opening up.

On this point, at least, Sheikh Hamad’s open-minded reforms appear to be welcomed by many of the young. No one on the escalator seemed the least bit unhappy. □

#### WEBSITE EXCLUSIVE

Share your thoughts on war, oil, and the prospects for democracy in the Middle East as well as view a photo gallery at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).



H O T S P O T S

PRESERVING PIECES OF A FRAGILE WORLD

# Islands of



# the Pacific

BY MICHAEL PARFIT    PHOTOGRAPHS BY TIM LAMAN

By what and why, birds like these terns have found their way to the scraps of land fragments known as islets. On the islets, many are evolving into species. As the islets erode, though, biodiversity may soon disappear as the winds of change start to blow.





**On the edge of nowhere,** the island of Nuku Hiva is part of the Marquesas Islands in French Polynesia. Though 3,000 miles from any continental landmass, it harbors abundant plant and bird life. How did life get here? Scientists agree most came by



**way of islands to the west. But that west-to-east flow is only part of the story. When life arrives in a new environment with different flora and fauna, much of it changes. "Evolution needs two things: isolation and time," says conservationist Philippe Raust. "It had both here."**

“It is a love story,” Noah Idechong said as the boat moved slowly through water that was murky but should have been clear. “It is a love story, and the *biib* is the beautiful girl, and the tree is the boy, and the mother is a giant clam.” Then the conversation drifted to why so much silt had clouded the river, and Noah, a prominent conservationist in the area, didn’t finish. It was many miles across blue water and through brown water before I learned the full story. It turns out to be a lot like the story of biodiversity on the islands among which I was traveling: beautiful, intense, complex, and troubling.

I met Noah on the island nation of Palau, one of nine independent countries, eighteen territories, and one American state (Hawaii) that make up the Micronesia-Fiji-Polynesia biodiversity hotspot. It is one of 25 areas that Conservation International, an environmental group based in Washington, D.C., has identified as rich in endemic species in danger of extinction. The hotspot includes over 1,400 islands, scattered across an expanse of ocean more than twice the size of the continental United States.

I was heading from west to east across the hotspot and had started in Palau in part because I wanted to meet one of the characters in Noah’s story—the *biib*, the beautiful girl.

In reality the *biib* is a bird. It’s the name that the people of Palau have for a species of fruit dove that lives only in their archipelago. I went looking for the *biib* and its far-flung relatives because, as descendants of doves that migrated across open water from Southeast Asia, evolving as they went, they are symbols of a scattered but dynamic place. This place is a great crucible, a smithy of life, a place where you can still hear the clang of the hammer of evolution beating out new shapes on the anvil of the world.

But my searching had a wider goal too. The more I traveled here, the more I realized why this place is so important and why it is in danger. As I looked in the branches and listened to distant birdsong, I hoped to find that perhaps there is also an evolution being hammered out here in the human attitude to the Earth’s wealth of life.

You can see the importance of this region first

in numbers. Fully half of the plants here—3,334 species to be exact—exist no place on Earth but these islands. Strikingly, this high percentage is found on a relatively tiny amount of land. The land surface of this hotspot is only about 18,000 square miles—less than the area of Vermont and New Hampshire combined.

But these are just numbers. My search for the *biib* and its relatives took me on a journey where numbers melt in the heat and are washed away by pounding rain and where the uniqueness of one individual tells the story of millions.

I first heard the call of the *biib* near a lake where I went to swim with jellyfish—intentionally. I did this, well, rash thing because the jellyfish here are a perfect example of the constant restlessness of evolution on islands.

Islands form unique ecosystems mostly because the species that end up living on each island arrived there by chance. So a species that reaches an island will probably find a different kind of neighborhood from the one it left.

To survive, the life that’s arrived will change to fit the new shape of its niche. In a way, then, each of the 1,400-plus islands of this hotspot is its own factory of evolution. In Palau this quality of islands reaches a wonderful complexity.

Many of Palau’s islands are made of ancient limestone pockmarked with sinkholes and porous with caves and tunnels cut by flowing fresh water during past ice ages. At the end of the last ice age, more than 10,000 years ago, glacial ice melted, seas rose, and water percolated through this natural stone plumbing system to fill the sinkholes and create new lakes. The plumbing is big enough that the inland water is salty and responds to the ocean’s tides, but is small enough to isolate the lakes from the full panoply of sea life.

“In a way, these lakes are the marine equivalent to the Galápagos Islands. Because of their isolation, they can show how marine species evolve,” said Laura E. Martin, a biologist with Palau’s Coral Reef Research Foundation who is working with her husband, Mike Dawson, also a biologist, to examine this idea.

To swim with the jellyfish, Laura and I and two of her colleagues boated to an island south of Palau’s capital city of Koror. We hiked a few hundred yards through a forest across a sharply



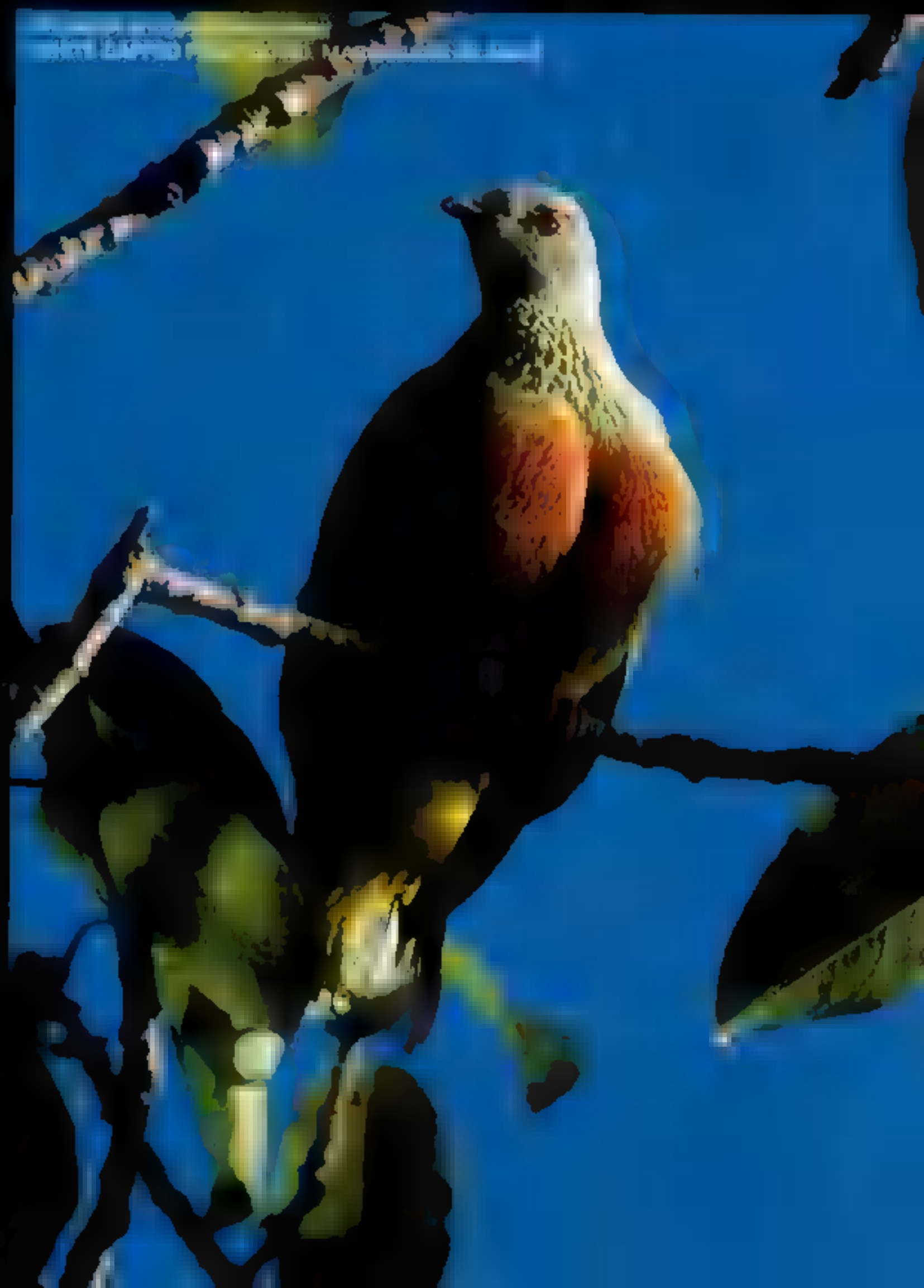



*Ptilinopus pelewensis*  
(PALAUAN FRUIT DOVE)



*Ptilinopus victor*  
(ORANGE-BREASTED FRUIT DOVE)

**Evolution struts** its stuff in the elusive biib (above left) and other fruit doves, which share common ancestors. The challenges each island posed—different fruits and berries, more or fewer predators, and varied microclimates—forced dramatic adaptations, including, perhaps, these brilliant hues. But colors don't help against more recent imports like rats, feral cats, or mongooses.





A maze of islands, reefs, and seawater lakes in Palau shelters evolving creatures like the *Mastigias* jellyfish (opposite, top), whose synchronized swimming—unusual among jellyfish—may indicate a new species in the making. In Palau's rain forests, where an *Ixora* blooms (opposite, bottom), many species remain unknown.



eroded limestone ridge, put on snorkels and fins, and swam out into the lake's 86-degree water.

I was immediately surrounded by hundreds of pulsing golden blobs. Jellyfish bounced softly off my mask, slid down my arms and legs as I swam, brushed against my neck, arms, feet. There are literally millions of these *Mastigias* jellyfish in the lake, so there was no escaping their caress. Fortunately they sting so mildly that most of the time it's unnoticeable.

The jellyfish in the lake are not yet identified as a separate species, but over the millennia they have evolved a unique way of life. Every morning they gather at one end of the lake, then migrate in unison across the water, each jelly sunning the gardens of algae that grow within its body and provide much of its food, most swimming close to the shadow line cast by mangroves at the water's edge. In the afternoon they move back across the lake, then descend to deeper water to absorb crucial nutrients.

Why this elaborate ritual? It could be because, unlike similar saltwater lakes here, this one has a robust population of sea anemones along its underwater shoreline. Anemones eat jellyfish, so it's possible that the jellyfish evolved this pattern of clinging to the shadow line to avoid the lake's lethal edge while still maximizing their sun exposure.

In a way this group behavior, seen nowhere else, is a snapshot of evolution in action, a species starting to diverge from its fellows, heading out on an expedition toward something altogether new on the face of the Earth.

On the way back to the boat from the lake I heard my first biib. Its call was a series of hoots strong enough to carry a long way but colored slightly with a tone I found melancholy. Each hoot was shorter than the previous, a cascade of sound that finally stepped down into silence. I looked around, but I couldn't tell where it was coming from.

I was once warned by an ornithologist named Phil Bruner, co-author of *A Field Guide to the Birds of Hawaii and the Tropical Pacific*, about how

## H O T S P O T S

The Earth's richest and most threatened reservoirs of plant and animal life

### ISLANDS OF THE PACIFIC

**LAND AREA** 18,000 sq mi

#### HABITAT TYPES

Beach vegetation, cloud forests, mangroves, rain forests, savannas, shrublands

#### FLAGSHIP SPECIES

Bola snake, honeycreepers, iguanas, land snails, silverswords

#### ENDEMIC SPECIES

3,334 plants, 174 birds, 9 terrestrial mammals (all bats), 37 reptiles, 3 amphibians (all frogs)

#### PRINCIPAL THREATS

Invasive species, agriculture, logging, hunting, global warming

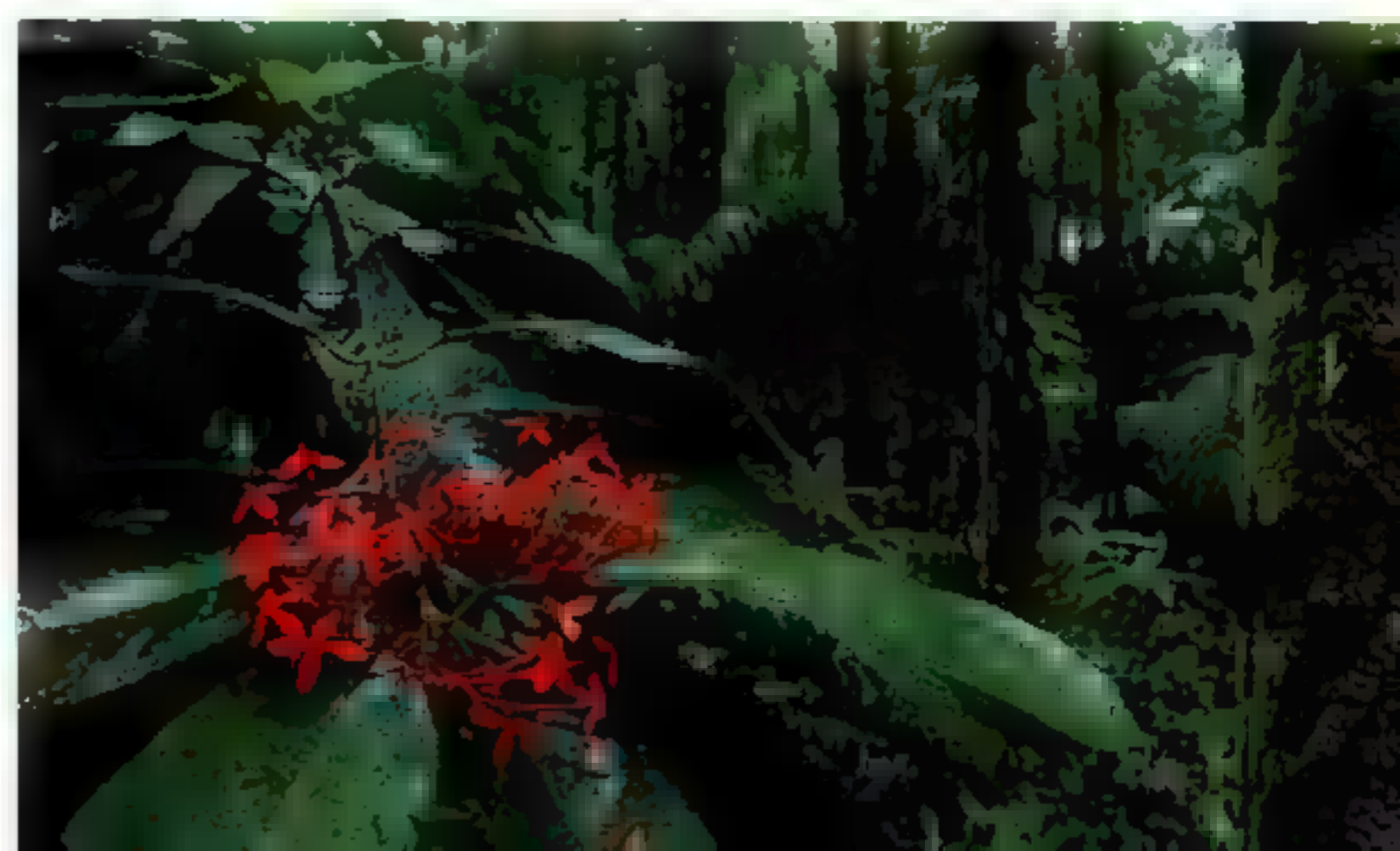
difficult it is to find fruit doves by sound. They are almost like ventriloquists, he said: "They're here, but actually they're there."

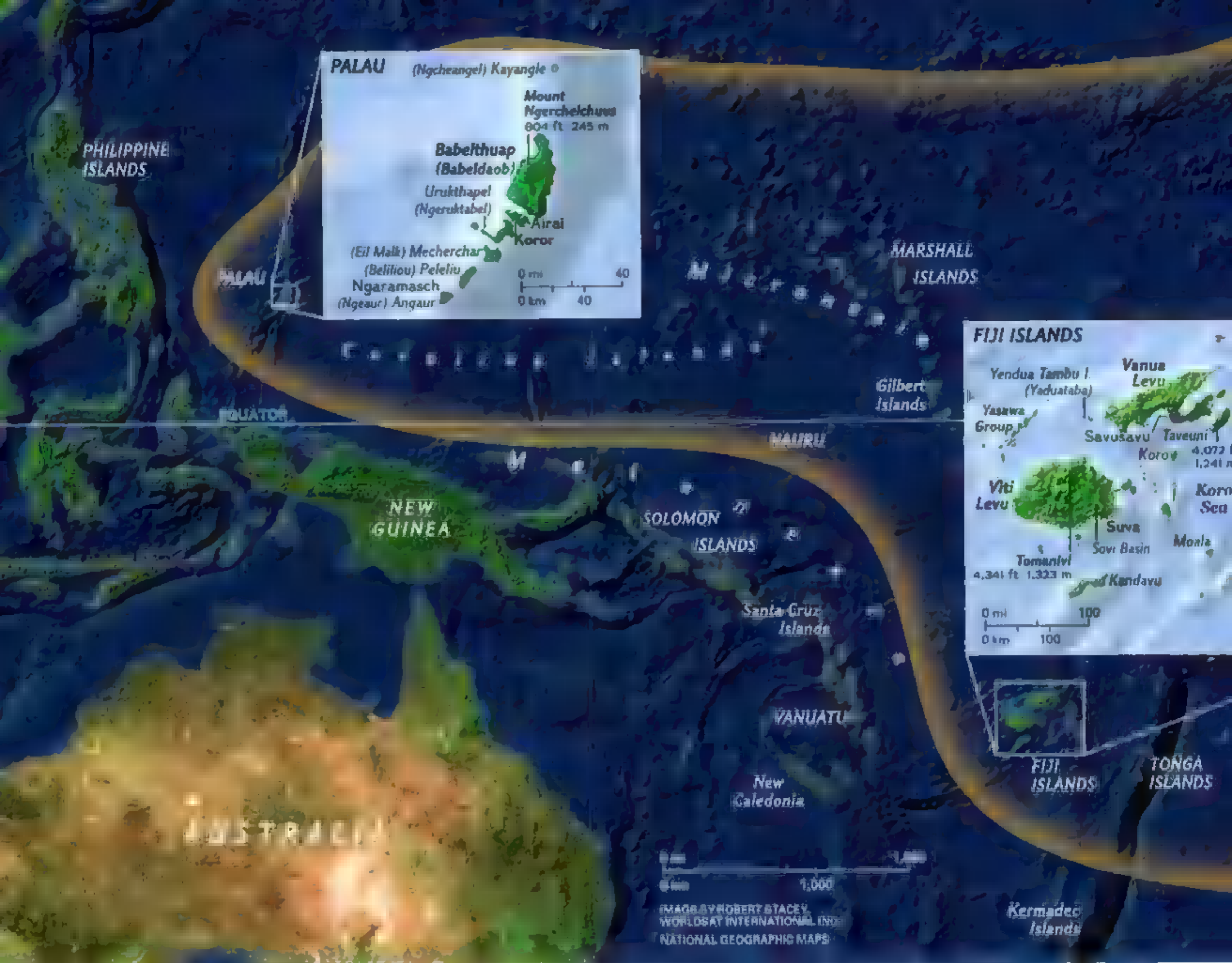
**M**y search for the biib's relatives soon found me 3,500 miles southeast of Palau, slogging through rain-saturated pastures among people who I hoped might reveal a relationship to the land older and perhaps wiser than ours.

The place I was trying to reach was the Sovi Basin, considered the last lowland forest on the Fijian island of Viti Levu left undisturbed by logging. Led by a group of villagers, a Fijian botanist named Marika Tuiwawa and I hiked through mud for miles and eventually arrived at a remote camp at the mouth of

a gorge. We had reached the basin, but I had yet to see a dove. The ventriloquist call had floated through the trees—here, no actually there—but once again the birds were hidden.

That evening, as the song of another bird, a





giant forest honeyeater—a bit like the call of a Manhattan police car in a crowded intersection—announced the coming of night, Marika and I sat in an old hut with the rest of the group. In the hot night the young men lay shirtless on a tarp, some rolling long, thin cigars out of tobacco leaves and strips of old newspaper. These men were still deeply connected to ancient Fijian traditions and the land. All knew how to use the plants in the forest to heal cuts, treat dysentery, or cast or break a spell. When a hunter has not been finding pigs, one of them said, you make a hoop with a vine. When the hunter and his dogs go through the hoop, the bad-luck spirit cannot follow.

Just as I wanted to see fruit doves, so I wanted to hear something from these men about how to save the land. But that hope was also to prove elusive. Though their leaders are working with conservationists to try to find a way to protect the basin from human encroachment, the men with us still had an instinctive sense—so true for human beginnings, so false today—that

humans are a tiny presence in the land's grandeur and that individual actions have little power to damage the land's wealth or beauty. It reminded me that what often looks like mere human carelessness is in fact deeply rooted in attitudes that for so long were necessary for survival. They use everything that comes to hand, and because they are few, their actions seem harmless. To float bananas downriver, they cut bamboo for rafts they use just once. And when I asked if there was a place to use for a toilet, the answer was simple: the river.

I come from a more crowded world. I went up into the woods and dug a hole.

**I**went on looking for doves and hope. Fruit doves made it long ago to Fiji, where three of the islands' species of fruit dove are endemic. Their star is the spectacular orange dove. I hiked on Taveuni in the foothills of the mountain range that makes up the island's long, narrow spine. Deep in the forest I heard an odd tocking sound, something like



Scattered over more than eight million square miles of ocean, the roughly 1,400 islands of the Micronesia-Fiji-Polynesia hotspot make up a tiny landmass of surprising diversity. Ranging from specks barely above sea level to the peaks of Hawaii, these isles of lava, coral, and limestone owe their existence largely to volcanic action. Palau, Fiji, and the Marquesas offer a representative glimpse of this lush, vulnerable nursery of life.

what you might hear if a small dog were trying to imitate the sound of a clock.

This sound wasn't dove-like. But it was a dove. And this one wasn't a ventriloquist: It was here, and it was really here. All I had to do was look where the sound came from.

Here I was, finally seeing a fruit dove up close. And I didn't believe it. No bird could be this bright; this had to be a gaudy flower or a leaf gone to brilliant orange. But then its head moved. It was, in fact, an orange dove.

The dove sat in the tree's branches, as loud as a used-car commercial. No one knows why this dove's distinctive plumage is so brilliant, whether some combination of mating rituals or camouflage played a role in its evolution. But this much is clear: Once again the uniqueness of a place had brought out the uniqueness of a species and created a living being that could be found nowhere else on Earth.

The orange dove heard me in the shadows and fled. Once it was gone, I couldn't even imagine it anymore.

**T**here is not much land east of Fiji: On a world map the islands there look like scattered grains of sand. Exactly why fruit doves found their way to the Marquesas Islands, a remote piece of French Polynesia almost 3,000 miles northeast of Fiji, is another mystery unlikely ever to be solved.

"Why not other groups? Why not woodpeckers?" Phil Bruner asked, baffled himself about why doves and pigeons have been so successful at dispersing over the Pacific while other birds from the same source area have not. "The islands are so small that it's hard to believe the birds could even see them from the air to find them," he says.

But they are here. I was not in the Marquesas more than a few hours before I heard my first Marquesan fruit dove, known as the white-capped fruit dove. The sound was almost exactly like the biib, the cascading hoot that still struck me as the melancholy call of the wanderer.

On the island of Ua Huka photographer Tim Laman and I waited under trees on steep



hillsides for doves and other birds to feed. Tim focused his attention and big lenses on the endangered ultramarine lorikeet, also known as the *pihiti*, a bird that both in flight and on a fruit tree seems incorrigibly enthusiastic.

In flight the *pihiti* dashes along on a fast flutter of wings, calling repeatedly with a sound between a hiss and a trill. When it lands to feed, it clambers all around a mango or a fig, sometimes hanging below the fruit for a quick jab or scrambling on top to sink a dripping beak in the fruit's warm flesh. And everywhere it goes, the *pihiti* flashes the world a dazzling blueness that brings the essence of the sea right into the treetops.

One afternoon we found ourselves with several Marquesans in a grove of mango trees on the side of a hill. The canopy seemed awash in sunlight, with drips of luminous gold pooling

on the ground. The air was dreamy with ripeness from laden branches and rot underfoot.

Once in a while there was a muffled thump as a mango hit the floor of leaves. From far above we could hear both the buzzy trill of the lorikeet and the hoot of the fruit dove. We had glimpses of birds, but mainly they were just rustles in the treetops. They were here, no there, no actually over there! Eventually we all sat down on the aromatic softness of the old leaves while one of the Marquesans chopped the tops off some fresh coconuts with his cane knife and passed them around for us to drink. It was like being inside the fecundity of life itself.

Except for one thing. Like the Palauan story of the *biib*, this place was not just about love but also about death.

When I finally heard the rest of the story of the *biib*, it turned out to be grim. It was about



**Volcanic and complex,** Fiji's 300-plus islands are about 35 million years old, yet less than 3,000 years of human presence has driven many species extinct, including a giant pigeon, an iguana, a crocodile, and a giant frog. The nation's third largest island, Taveuni (left) rises to 4,072 feet and is often shrouded by clouds, providing a moist niche for endemic plants like the *Dendrobium prasinum* orchid (above).

a girl and boy who fell in love, but the girl was married to a chief. Then she got leprosy and was shunned. But the boy returned and treated her with a magic herb, which cured her. Yet as they escaped by canoe, the girl's mother plunged into the sea and turned into a giant clam. Desperate, the girl dived in too and drowned.

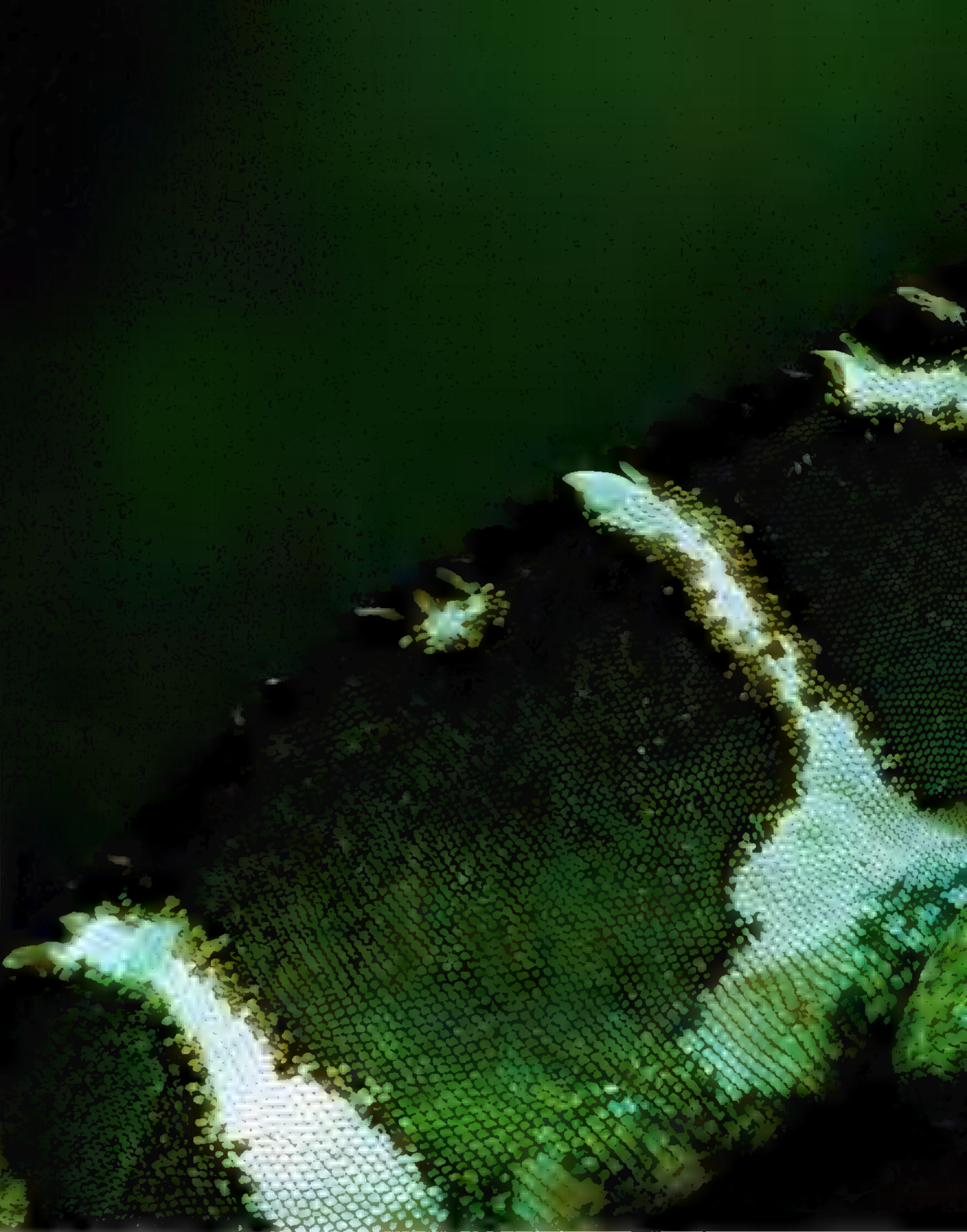
Noah Idechong had said that the story was somehow a symbol of the relationships of birds and land and sea, and I had hoped for a happy ending. But the story of life in this place doesn't necessarily come out the way we would like.

The threats are familiar: Among them are industrial and urban development, logging, and agriculture, which all lead to habitat loss; the hunting and trapping of native species; the introduction of alien species that compete with the natives or prey on them; and the threat of global warming, which is particularly acute here

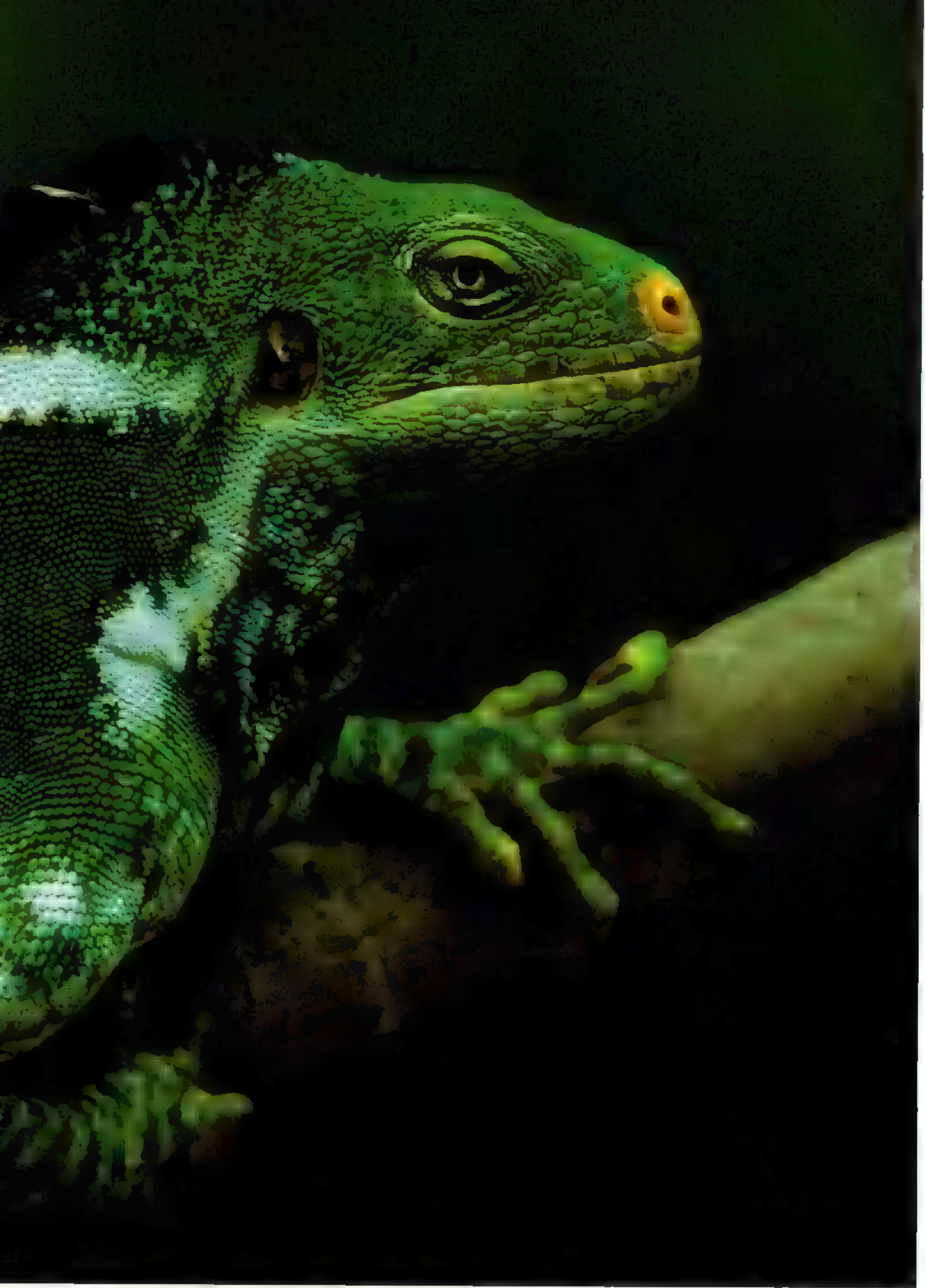
because if melting ice causes the seas to rise much at all, many islands will shrink or simply disappear.

I saw examples of some of these dangers all along my journey. In Palau I saw silt from construction of a new 150-million-dollar road around the country's biggest island pouring down gullies toward the sea. I drove around with a scientist named Joel Miles, who showed me several species of invasive vines and grasses whose seeds are carried on construction equipment or shoes.

In Fiji I saw a black rat nosing around by a seawall—an introduced species on several of the islands that's a deadly killer to many native birds. On the hike to the Sovi Basin I saw a curious track in the mud ahead of me and asked Marika Tuiwawa what it was, and he said "Mongoose." *(Continued on page 122)*



**Fiji's crested iguana** wears a bored gaze, but its history is anything but dull. ■ was believed to be one of the few species to have arrived in the islands from the east, but new research suggests its ancestors may have migrated directly from Central Asia many



millions of years ago. Discovered as recently as 1979, the crested iguana is more primitive than other members of the iguana family. It is also more rare. Thanks to introduced species like feral cats, it is now found in large numbers only on the tiny Fijian island of Yaduataba.



PHILIPPS BOLITARIUS (COLLARED LORY)

**Riotous in color** or in song, Fiji's abundant life, including red-tipped ferns (left) and myriad birds, must adapt or die. Development and agriculture have wiped out some endemic plants and brought in non-native species. The collared lory (above) has adapted by eating cultivated cassava, and giant forest honeyeaters now feed on introduced ginger (right).



PLANTIUM GIGANTUM







The mongoose, introduced to kill rats, also wipes out birds by eating eggs.

In the Marquesas, on Ua Huka, I watched goats and horses wandering in search of forage to the highest ridges of the volcanic hills, eating right down to bare ground. And the very appearance of that paradise in the mango grove in which we had been sitting was also a symbol of danger; though not invasive, both the mango and coconut are introduced species. By occupying space and sunlight that native plants once used, such alien species can sometimes compromise the diversity that is so vital to the factory of life.

Because of these things more than three-quarters of the original vegetation in this hotspot has been lost or changed since humans first began arriving here 3,500 years ago. Dozens of birds are now extinct; the list grows

longer as archaeologists uncover the bones of hitherto unknown species in the kitchen middens of ancient villages. Some have vanished quite recently.

One of the fruit doves is among them. "Into the 1920s we had the red-moustached fruit dove," said Philippe Raust, a conservationist from Tahiti. "No longer."

And many threats that have not been realized remain poised. The island of Ua Huka, for instance, has a robust bird population partly because black rats have not yet reached its shores. The island's harbor is not deep enough for oceangoing ships, which often carry rats in their holds, to rope up to a wharf on the island; all cargo is first off-loaded onto smaller boats on which rats seldom travel.

Yet the safety is fragile. "If rats got on Ua Huka," says Mark Ziembecki, an ornithologist



**Sooty terns soar** over their rookery near Ua Huka island in the Marquesas. Islanders (above) scale the cliffs to harvest in one day thousands of tern eggs—a seasonal part of their diet. Twenty years ago the mayor of Ua Huka placed another island (left, background) off-limits in the interests of conservation. It seems to have worked: Tern numbers have stabilized.

studying the island's birds, "it would be all over for the pihiti in ten years."

**I**n designating this area as a hotspot, conservationists imply not just that there is something still worth saving here but that there is reason to believe it can be saved. Yet, as I had seen in Fiji, there is not necessarily any great human wisdom waiting to emerge from the past, like an ancient medicine from the bark of a tree, to save us from ourselves. Human beings, like a wandering species that has reached an island of experience unlike anything that it has ever seen, have no choice but to evolve a new behavior—like the jellyfish back on Palau. Maybe, just as the glimpse of the orange dove that for a moment seemed so vivid, a bit of that evolution can be seen here too.

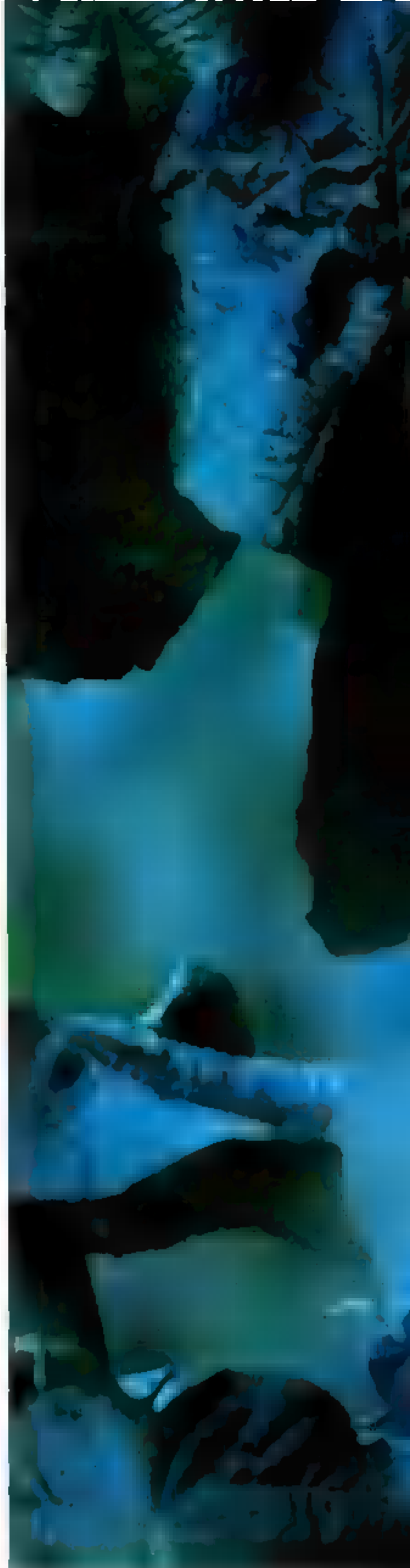
In the Marquesas, Leon Lichtle, the longtime

mayor of Ua Huka, told us with pride about protecting a seabird colony by confiscating the boats of those who poached. "The first person we caught was my father," he said, laughing. And Philippe Raust is leading a grassroots effort to save the critically endangered *upe*, the Nuku Hiva imperial pigeon. "Before people came," Philippe said, "birds were kings of these islands, and the imperial pigeon was king of the birds."

In Fiji I hiked a trail into the mountains with a 61-year-old tour guide named Aisake Tale. His village had a chance to sell forests that contain, among other treasures, kauri trees hundreds of years old. The village turned the money down.

"We say we keep our trees, you keep your money," Aisake said. "To sell to the businessman, you cut it once. But with ecotourism we sell the same tree every trip. Very good."

And in Palau, Joel Miles, the invasive plants



**Hoping for a comeback:** Lucien Bonno gathers seeds of rare Marquesan sandalwood trees. The seeds will help replace trees lost to overharvesting. On Nuku Hiva, a *upe* (right) pipes up in the face of extinction. Fewer than 200 of the pigeons survive. “We do not want to be people who describe only extinctions,” says conservationist Philippe Raust, whose work to save the *upe* is one of many conservation efforts across the region. “It is impossible to say it’s OK that these birds are going to disappear.”

specialist, had been delighted when he took me to see a patch of invasive grass and found that members of Palau’s bureau of agriculture had taken it on themselves to eradicate it. “I have hope,” he kept saying. “This is great!”

Then, also in Palau, there had been the boat ride with Noah Idechong, where I first heard about the *biib*, the tree, and the giant clam.

Back in 1994 Noah led the development of an activist organization called the Palau Conservation Society; he’s since received several conservation awards, including the internationally known Goldman Environmental Prize in 1995 and a *Time* magazine citation as a Hero for the Planet in 2000.

Noah is now a member of Palau’s congress. On a Saturday morning he took me in his boat with several conservationists, including a noted visitor, Margie Cushing Falanruw, director of Yap Islands’ Institute of Natural Science. The trip was designed to show the visitors a bay and estuary that have been protected in part because of the conservation society’s campaign.

The boat roared through the bay and turned up a tributary. After a while the river grew narrow, and Noah shut down the outboard. The forest seemed peaceful and intact.

But then we heard a rumble in the distance—construction on the new highway. The water was brown with silt that had seeped down from



the work sites. We knew that this murky water, bound for the sea, might end up damaging the nearby coral reefs.

“The thing about islands,” Margie said, “is that you can see the connections. It’s easy to understand the problems on a small island, and that’s probably the value of small islands to the whole world.”

As we drifted along, we passed a nest a biib had made in an overhanging tree. It was a tiny structure of twigs far out on the slender end of the branch. It was like one of those toothpick structures that engineering students make, which look absurdly delicate but create a web of strength. These tiny nests at the ends of

branches—beyond the climbing reach of rats—are among the reasons that biibs survive.

Who knows what other survivors there will be? The story of the biib and the tree and the giant clam ended in tragedy, but the end to this one hasn’t yet been written.

Somewhere in the woods the biib that had made the nest called distantly, and I looked around, hoping to see her at last. She was as elusive as hope but just as real. She was there, but maybe she was actually here. □

**WEBSITE EXCLUSIVE**

Will the “Hotspot” approach to conservation work? Weigh in with an opinion on our forum board and get resources at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).



Chopsticks and Coke are equally at home in Oklahoma City's Little Saigon. Hoc Nguyen, left, a former lieutenant in the South

# 73106

## Lemongrass on the Prairie



BY FRANK BROWNING

PHOTOGRAPHS BY PENNY DE LOS SANTOS



73106

**POPULATION:** 13,500  
**NUMBER OF VIETNAMESE IMMIGRANTS IN OKLAHOMA CITY IN 1975:** 2,000  
**NUMBER IN 2002:** 12,000  
**RANK OF CITY'S VIETNAMESE POPULATION IN U.S. METROPOLITAN AREAS:** 19  
**#1 RANKING:** Los Angeles

A sense of the surreal swirls up like prairie dust as you drive through Oklahoma City and pull up to the flat, sprawling intersection of 23rd Street and Classen Boulevard. Just ahead hovers a giant golden geodesic dome, built by a local bank in 1958. Across the street, atop a trapezoidal hut, stands a 15-foot-tall white milk bottle (emblazoned with a pink ice-cream cone). A couple of blocks beyond rests a Gothic church, its enormous stained-glass windows sheltered by carved gray stone.

Somehow it's not where you'd expect to find a thriving community of Vietnamese, locally known as Little Saigon, the fragrance of lemongrass, garlic, and hot chili paste drifting out from a garish string of strip malls. Ten minutes away from the intersection, the heart of Little Saigon, you can easily walk to five restaurants specializing in *pho* (the classic Vietnamese beef broth soup), two Asian supermarkets, and several Chinese barbecue cafés.

The afternoon Loan Nguyen arrived in Oklahoma City in August 1980 remains as fresh as yesterday. Having left a refugee camp in Thailand, Loan, her husband, Thuong, and four children walked down a set of steel stairs onto the roasting tarmac at Will Rogers World Airport: "It was hot," she remembers, "like going into the stove." Thuong had been a bone surgeon in Vietnam, and within two years he taught himself enough English to pass relicensing exams and undergo retraining as a family physician. Loan found a job with Coca-Cola, selling soft drinks to Asian convenience stores. In 20 years they have put four of their six children, plus a son-in-law, through medical school.

Thuy, an elegant, feisty young woman, is the eldest of the four doctor children. "In our family you grow up to be a doctor or else," she says, taking a break between patients in her two-room office a half mile down 23rd from her dad's. When she and three siblings were in high school earning straight A's, they were expected to concentrate on homework; the television was to be on just an hour each night. To enforce the rule, Thuong encased the television in a plywood box so that

Kevin and Chilan Nguyen (bottom, center) greet their wedding guests wearing red, a Vietnamese symbol of good luck. A symbol of community, the golden dome (below, foreground) is slated to become an Asian cultural center. Khanh Tang, one of the city's two Vietnamese-speaking police officers, patrols Little Saigon.







**GET OFF**

(Okay, it may seem like I hate my parents, but I'm really demonstrating what a therapist would call "asserting my identity," so I can grow up to be a well-adjusted individual. Sure, I say I want freedom, but without parental supervision, I'm much more likely to smoke pot and stuff. I hope my parents don't try to act like my friends. What I really need is parents...)

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OKLAHOMA CITY, OKLAHOMA



LONG HEO	: 5.00
GIÒ LUA	: 5.00
CHẢ CHIÊN	: 5.00
BÁNH CUỘN <i>chả lụa</i>	: 4.00
CHÁO LÔNG	: 4.00



Ha Ngo and Khach Pham, married for over 50 years (above left), navigate the city streets without English (or drivers' licenses). At Hop Ky restaurant, where the menu (top) lists traditional fare, former South Vietnamese Gen. Be Tu (left, second from right) talks with other ex-soldiers about "how to preserve Vietnamese customs." A monk (above) blesses temple member Le Thi Mul, 91, who lives in the area with four generations of her family.

after the hour was up he could padlock it shut. Thuong and Loan still live in the same one-story brick house they bought for cash 17 years ago, two doors from a nearly identical house where he keeps his office. Thuy lives in a two-story, upscale suburban house half an hour away.

"I don't want to live in an old, small house," Thuy says. "I'm living the American dream. We grew up poor. We want to move up in society."

That tension between the bonds of tradition and the blandishments of the American dream sizzles all across Little Saigon. Stop by Su Nguyen's Hop Ky café most any morning around 10 and, if you speak Vietnamese, you can hear Su trading stories with his old military buddies about their grandchildren and the mistakes that lost the war. One large South Vietnamese flag is tacked to a wall, another flies in the wind outside, and a third sits beside the Stars and Stripes atop an old deli case stocked with pig intestine, roast duck, and stuffed buns.

Three veterans in their 60s sip tea with Su. All, like him, went to prison for several years after the fall of Saigon; some spent more years in refugee camps.

"They come here every morning; some are retired, others work night

**The tension between the bonds of tradition and the blandishments of the American dream sizzles all across Little Saigon.**

With a series of simple clicking sounds, he can teach a force of 200 men to hunt, to treat an illness, even how to find an appropriate mate.

### How well do you share?

Chief Obijol's method of disseminating critical information works exceedingly well to keep his organization on the same page. For others, sharing documents and images more effectively might be a good place to start.

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## OKLAHOMA CITY, OKLAHOMA

shift. It's a good place to talk and remember," Su says through my interpreter, Khanh Tang, a young Vietnamese-American police officer. Su arrived in Oklahoma City with the second wave of Vietnamese refugees in 1991. Most of the people who now live in Little Saigon came about the same time. The first wave, who were placed here by Christian refugee agencies in the '70s and '80s, have mostly moved to the suburbs. "The rich move out and poor stay in town," Tang says.

Two nights later in his patrol car, Tang inches along the small side streets of Little Saigon, lined with simple frame bungalows. He flashes his spotlight into the yards, most tidy, a few with backyard junk.

"I wouldn't want to raise my son around here when there's drug dealing, prostitution, shooting just down the street," Tang says, referring to a seedy neighborhood nearby. Even closer is one of the most exclusive square miles in Oklahoma. The possibility of either encroaching on Little Saigon has spurred community leaders to build up the neighborhood's civic institutions. When the golden dome was in danger of being razed, a committee of longtime Oklahomans launched a "save the dome" campaign. Their effort seemed hopeless until Irene Lam, who is one of several thousand Chinese in the city, offered to buy it to create an Asian cultural center.

"Asian people are always looking for public space to have community meetings, and there was nothing here," she says, taking me on a tour of the building. "Now we can have cultural displays, music, dance, there's so much open space."

A shrewd businesswoman, Lam quickly lined up enough retail businesses that rents would easily pay off the building's 1.1-million-dollar asking price. Lam also understood the cultural and political value of saving this icon of Oklahoma life: "We could say it's a way for Asian people to give something back to Oklahoma City for the good fortune they have had here."

Giving back. Holding on. Moving up. These are old issues among immigrants to the United States. Part of the attraction of Oklahoma City is its scale. Orange County, California, where the first flood of refugees arrived after the fall of Saigon, now is home to 135,000 Vietnamese; nearly as many live in greater San Jose. Housing prices in both are higher and urban tensions more severe. Still, the sprawl that is Oklahoma City casts families and friends apart. Loan Nguyen has watched her three oldest children move away, something that would be unthinkable in Vietnam. The children badger her and Thuong to move out of Little Saigon, to join them in the suburbs away from the "crime," but the parents say no.

"Our idea is anywhere crime can happen," Loan says. "Soon we will be too old, and our children not stay with us. When we are alone, it is very convenient to walk to Vietnamese stores. It is more comfortable to be alone here." □

### WEBSITE EXCLUSIVE

There's more on 73106  
at [nationalgeographic.com/  
ngm/0303](http://nationalgeographic.com/ngm/0303).

**"I pledge allegiance . . ."  
is coming a little easier  
for a hundred Vietnamese  
children learning English  
at the Asian Summer  
Program. Although the  
largest waves of Vietnam-  
ese immigrants arrived  
years ago, new families  
still come with hopes of  
thriving in the heartland.**



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to  
community center  
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Public transportation allows millions of people living in urban centers, like Boston, to get to work, school, and other destinations. Americans who grow older are likely to be able to get to the places they need to go. **By 2020, 40% of the U.S. population will be 65 or older, which makes public transportation even more important.** The next year, more about how public transportation can help our nation's most vulnerable people.

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# Final Edit



PUERTO RICO

## Why We Pulled the Taffeta

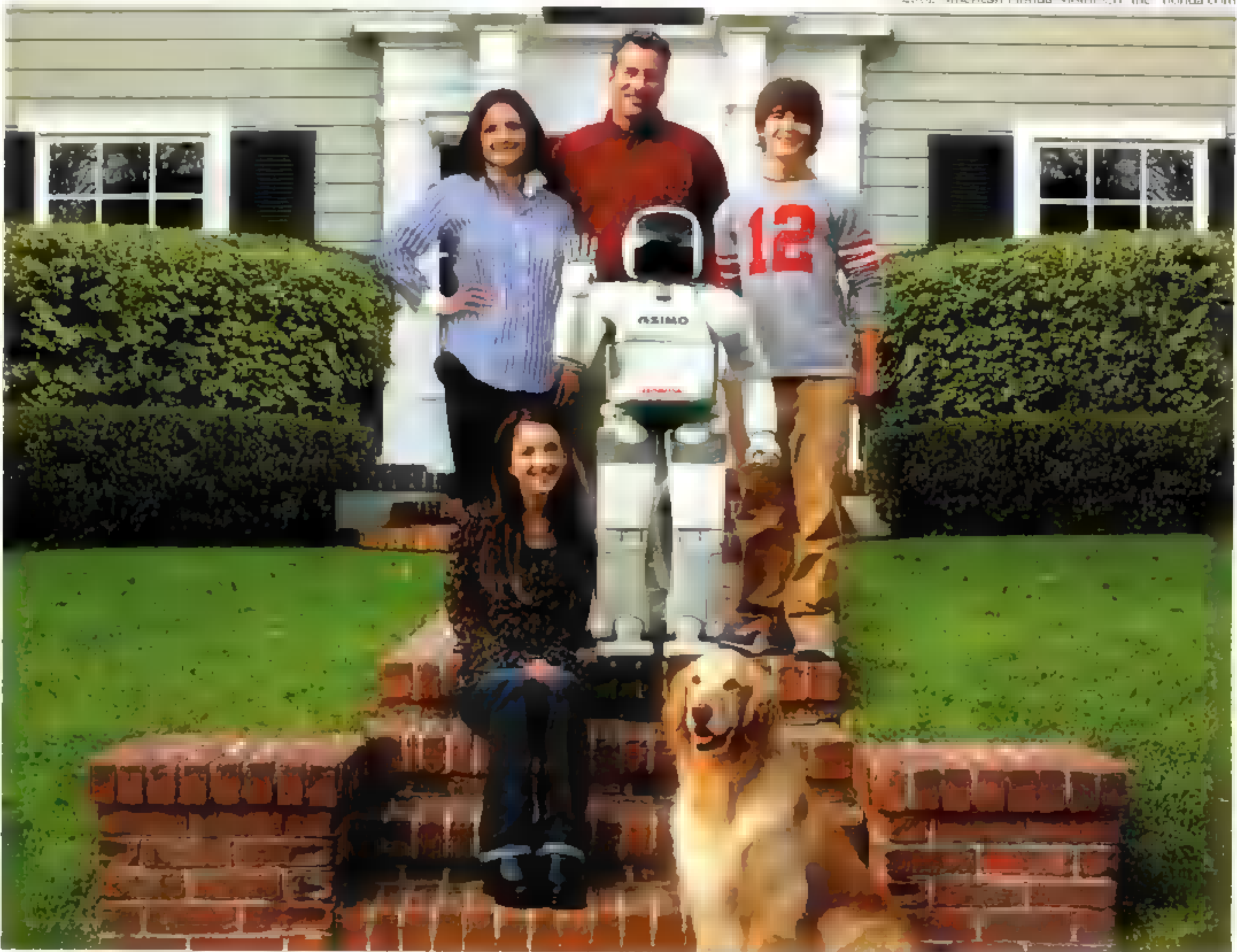
Early one morning, deep in Puerto Rico's rural heartland, photographer Amy Toensing found a freshly washed harvest—of formal wear. "I was driving around Utuado and saw these little dresses hanging on a clothesline. I just had to stop the car," she remembers. "There was something about those colors that really said 'Puerto Rico' to me."

But not to illustrations editor Susan Welchman. "Every photograph we use has to help tell the story about that particular place," she says. "This picture is beautiful, but it didn't do the job."

The dreamlike image did do a job on several female staffers, however. "You either had dresses like these when you were a girl, or wanted them," sighed one writer. "Not me," says Toensing, a child of the seventies. "I wore pants."

### WEBSITE EXCLUSIVE

Cut it or keep it? Find out more about what tipped the balance for this photo and send it as an electronic greeting card at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).



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The future of this exciting technology is even more promising. ASIMO has the potential to respond to simple voice commands, recognize faces, carry loads and even push wheeled objects. This means that, one day, ASIMO could be quite useful in some very important tasks. Like assisting the elderly, and even helping with household chores. In essence, ASIMO might serve as another set of eyes, ears and legs for all kinds of people in need.

All of this represents the steps we're taking to develop products that make our world a better place. And in ASIMO's case, it's a giant step in the right direction.

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# ON ASSI

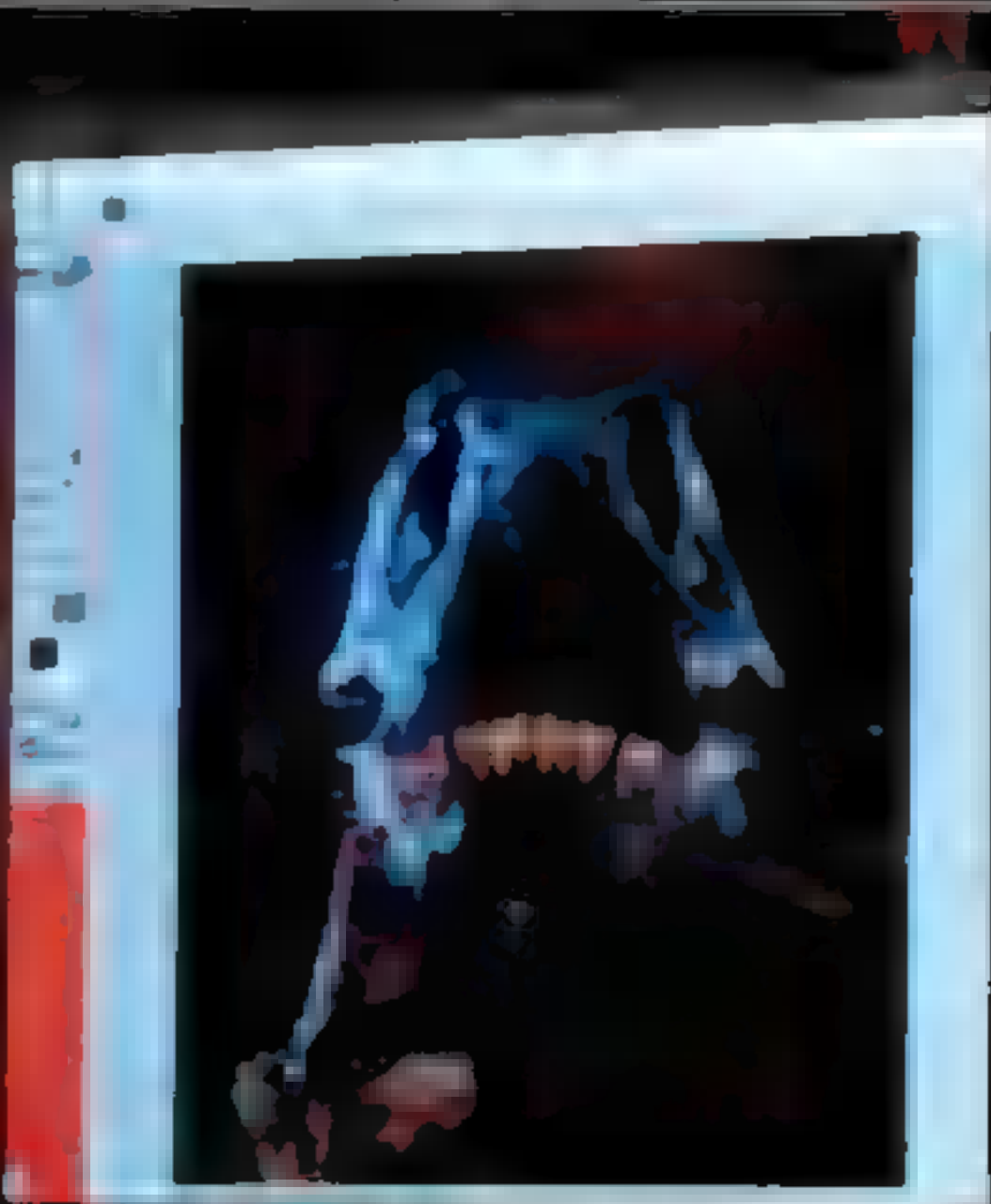
ON THE ROAD, IN THE FIELD





# COVERING THE NEW WORLD

C O V E R I N G T H E N E W W O R L D



HOW I GOT THE PICTURE

## Crunch Time

*Photographer Robert Clark describes the biting truth behind this month's cover*

Months before I took the picture, art director Chris Sloan and illustrations editor Kurt Mutchler had learned that a *T. rex*'s chomp was powerful enough to shatter bones, and they came up with a scheme to capture this on film. It turned out to be the smelliest shoot of my career.

Sculptor Brian Cooley sent us an aluminum, one-third-scale model of a *T. rex* skull. At the Society's headquarters, engineer Keith Moorehead and paleontologist Thomas Holtz rigged the model so that the jaws could be slammed shut by a blast of compressed air from a scuba tank (left). I then set strobe lights to

fire when the lower jaw broke a laser beam. A digital camera snapped the picture about a fifth of a second later. (Going digital let me see the results on my laptop soon after the exposure.)

It wasn't easy finding the right bones for our *T. rex* to bite. They had to look like a typical meal—another dinosaur. The best living model: a very big bird. We ordered dozens of ostrich bones from ostrich farms, some freshly butchered, and some—how should I put this?—ripe. The studio smelled like rotting flesh. Worse yet, there's nothing quite like goopy blobs of decaying bone marrow landing on your face.



DAVID COVENTRY (LEFT); REBECCA HALE, NGS STAFF



KHALIFA AL-UBAIDLY

## QATAR

## Talking Shop in a Royal Home

The last thing photographer **Robb Kendrick** expected when he sat down to dinner in the home of a member of Qatar's royal family, Sheikh Saud bin

Mohammed Ali al-Thani, was the subject of the evening's conversation: portrait photography. "Sheikh Saud is a big photography buff," says Robb. "He takes

pictures when he's traveling or observing wildlife, and he owns every camera and lens ever made." He's been on the other side of the camera too, having been photographed by Richard Avedon, Helmut Newton, Irving Penn—the world's best known portrait photographers.

## WORLDWIDE

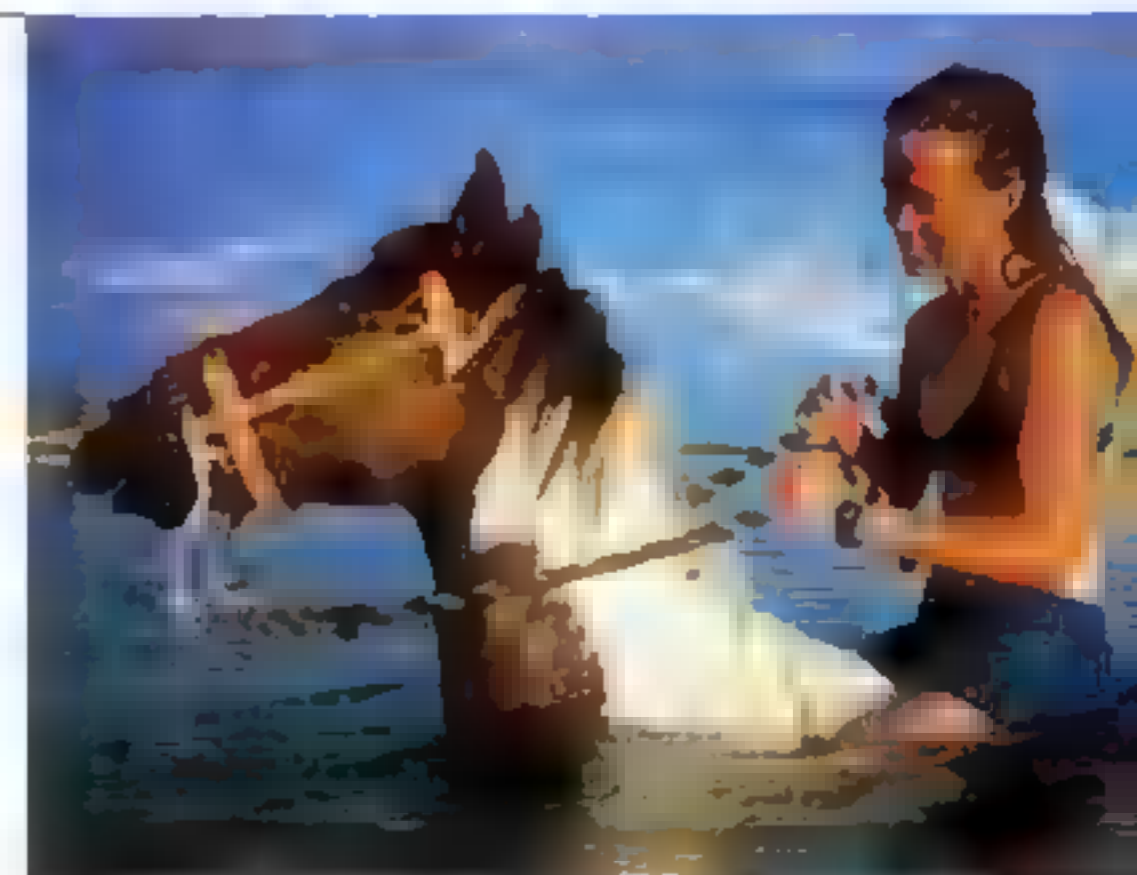
The Piper Super Cub is like "a motorcycle in the sky," says **Frans Lanting**. "There's room for the pilot and one other person sitting behind him." Frans shared that rear seat (below) with his wife, writer and producer Chris



PAUL CLAUS

Eckstrom, while photographing Wrangell-St. Elias National Park from as high as 16,000 feet. "We just barely fit," he says. "It only worked because we're married."

Author **Joel Achenbach's** latest feature stories for GEOGRAPHIC—life beyond Earth, light, and, for this month's issue, dinosaur behavior—"were about things nobody can touch," he says. "I keep waiting for an assignment on something like, say, Montana, so I can go to a place that's real and actually touch something." Joel admits the dinosaur behavior story gave him one opportunity for some intimate physical contact. "You haven't lived until you squeeze a ten-foot alligator around its middle and get it to barf up what it ate."



GWEN WIS1

Photographer **Amy Toensing** grew up riding horses, and loved cooling off in the Caribbean with a Puerto Rican Paso Fino horse. "It's a small breed, with a quick gait," she says. "You can feel its strength in the water."

## WEBSITE EXCLUSIVE

Find more stories from the field, including a video interview with photographer Robb Kendrick about life in Qatar, at [nationalgeographic.com/ngm/0303](http://nationalgeographic.com/ngm/0303).

A black and white photograph of jazz pianist Ellis Marsalis. He is shown from the chest up, wearing a dark suit jacket, a white collared shirt, and glasses. He is looking down at his hands as they play a piano. The background is blurred, showing what appears to be a stage or concert hall setting.

**Ellis Marsalis** is considered one of the world's premier jazz pianists. He's taught some of the world's most famous musicians. Even fathered a few of his own. But with retirement approaching, he **didn't want to improvise.** Not when it came to money. We worked with him on ways to make the most of his retirement plan, so money wouldn't get in the way of his music. Now he's ready for the next act, whatever that may be. Log on for ideas, advice, and results. [TIAA-CREF.org](http://TIAA-CREF.org) or call 800.842.1924

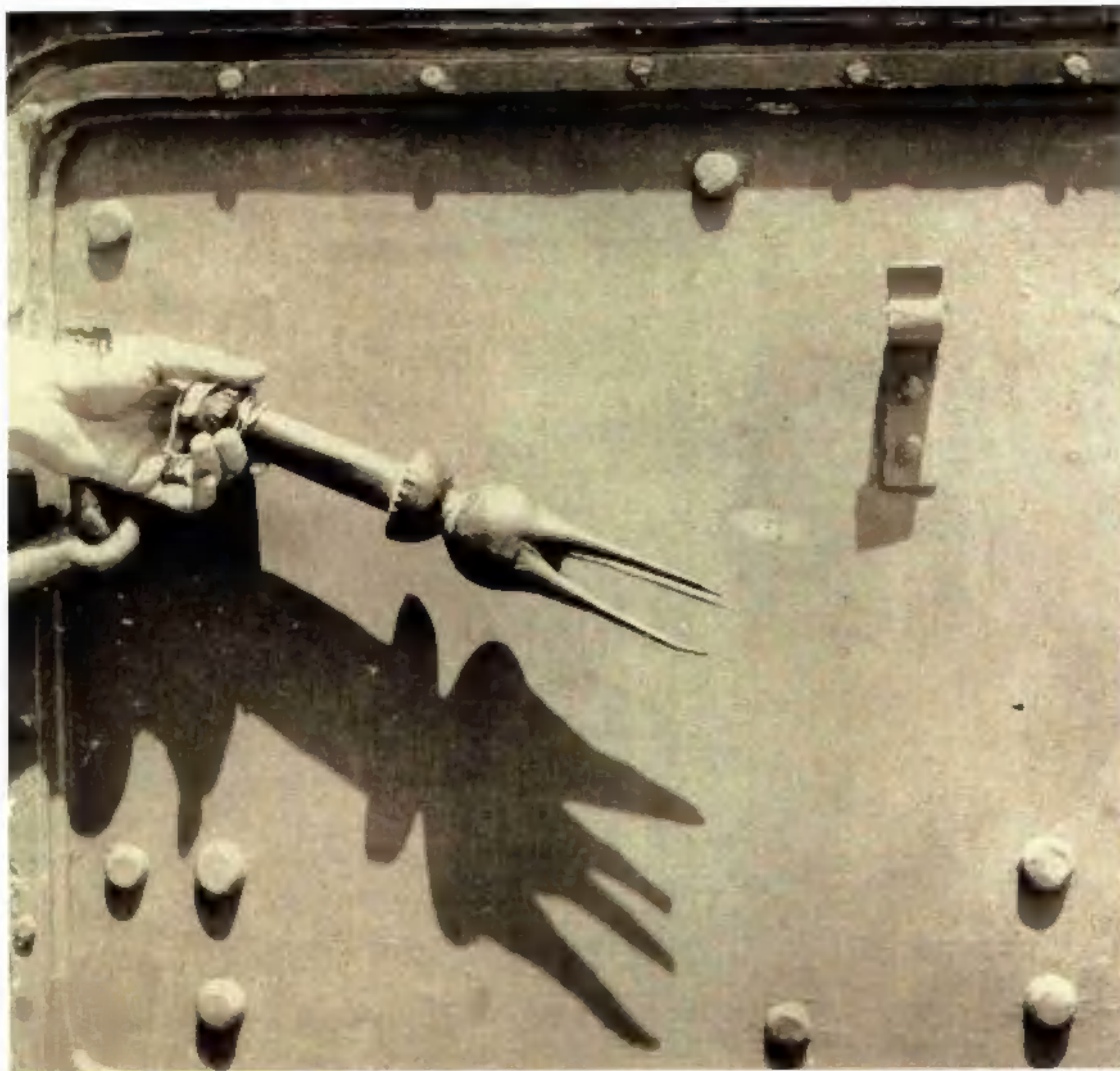


*Managing money for people  
with other things to think about.<sup>SM</sup>*

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Ellis Marsalis became a participant in 1990. TIAA-CREF Individual and Institutional Services, Inc., and Teachers Personal Investors Services, Inc., distribute securities products. ©2002 Teachers Insurance and Annuity Association-College Retirement Equities Fund (TIAA-CREF), New York, NY. Ellis Marsalis was compensated.

# Flashback



ROBERT A. BACHMANN

## ISLANDS OF THE PACIFIC

### For a Man-size Appetite

For centuries in the Fiji Islands, tribal officials would bring out their best utensils for special people, not to serve them, but to eat them. The tribal officials were cannibals, and the special people were the meal.

The cannibal fork, or *iculanibokola*, was used by attendants during ritual feasts to feed individuals considered too holy to touch food. The influence of Christianity ended cannibalism in Fiji by the close of the 19th century, but Western fascination with the grisly practice continued. In the late 1880s tourist demand sparked a brisk trade in counterfeit cannibal forks that continues today. Our records don't say if this photograph, acquired by the Society in 1917, is of the real thing or not. It has never before been published in the *GEOGRAPHIC*.

#### WEBSITE EXCLUSIVE

You can send this month's Flashback as an electronic greeting card and access the Flashback photo archives at [nationalgeographic.com/ngm/flashback/0303](http://nationalgeographic.com/ngm/flashback/0303).



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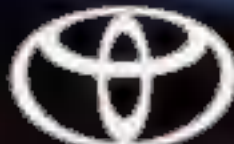
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